THE

TROPICAL AGRICULTURIST

AND

MAGAZINE OF THE

CEYLON AGRICULTURAL SOCIETY.

VOL. XXXIV. COLOMBO, MARCH 15TH, 1910. No. 3.

A JOURNEY AROUND THE WORLD. I.

We returned February 17th from a year's holiday, spent in journeying around the world, and a few impressions cellected during that time may be of interest.

We spent the first five weeks in Venice, Padua, and Verona, where there was little of agricultural interest to be noted, beyond the enhanced price of all produce in Venice, owing to the fact that it has to be brought in from considerable distances.

Proceeding to Lake Garda, we found the reverse the case: prices were extremely low, owing apparently to the fact that the railway does not yet touch the upper parts of the lake, though it reaches the two extremities. Food was remarkably cheap in Gardone.

From here right along through the Alps, the noteworthy feature was the enormous use made of water power. The whole country was intersected by electric tramways, and electric light was common in the smallest village. People who have only seen the electric car in Colombc, or in a level English town, do not realise the capabilities of such cars. We travelled from Innsbruck up to the Stubai-Thal along a road as steep as that from Nanuoya to Nuwara Eliya, at a speed as great as that of the up-country trains, and for an absurdly low fare. In Seattle or in San Francisco electric cars may be seen climbing streets as steep and as long as the upper hill between Nuwara Eliya and Hakgala. The car is placed on "Second speed" to do it.

Proceeding northwards through Tyrol, the great agricultural feature of interest is the co-operative wine-growers' associations, by aid of which the peasant is able to keep his feet against the big capitalist. For many years we have preached this doctrine in Ceylon, but it is slow to produce effect.

Staying for some time in Innsbruck, which was preparing for the centenary of Andreas Hofer, our host, who is the great chamois hunter of that part of the Alps, took me on an expedition up among the snows, in the course of which we came upon a herd of eight chamois. On this expedition, at one of the huts, I was given some "tea" in compliment to my nationality. About a tablespoonful of Ceylon tea was put into an infuser, and waved about in a large basinful of warm (not boiling) water for a minute or two. The faintly coloured liquid was then ready!

Passing through Bavaria, and southern Germany generally, we noticed large State forests, an institution which is badly needed in England and other countries. The United States have been

forced in self-preservation to establish large reserves, and Canada is being driven in the same direction. Timber increases continually in price, and the making of wood pulp is reducing the available supply more rapidly than anything else. When we stayed upon Puget Sound in 1902, it was necessary to burn all timber felled to get rid of it—it did not pay to haul it to the water. Now the same timber is very valuable.

In Germany we mainly stayed in towns, where though I had discussions with agriculturists and others, there was little of agricultural interest to be seen. I visited Hanover, and was shown by Dr. Prinzhorn all over the works of the Continental Rubber Co., and learnt from him a good deal that will prove of value in dealing with rubber. A point he insisted upon, and which may as well be brought in here, was that rubber should be packed in smooth boxes. I saw several of the rough boxes opened, with well-known names on the outside, and chips of wood, sawdust, and other debris were adhering so firmly to the rubber that it could only be removed by the washing machines.

A very noticeable feature in all the German towns, which has not yet appeared in England, was the Automat Restaurants. Entering, the room was bare but for tables and chairs, and had no servants in it. All round the walls were large belljars, about a yard across, with a floor of white porcelain divided into triangles, upon each of which was placed a little dish of something cold, beginning with Sardines and ending with cakes at the other end of the room. Putting 10 pf. (one penny) in the slot at the side of the machine, the floor of it revolves till one of the triangles comes opposite to the opening, when it dips down, and the dish slides out. You take this away and eat it, and return for something else. Further on are drinks. All kinds of beer can be got. You put a whisky-and-soda tumbler under a tap, drop in your penny, and the beer runs out. Tea, coffee, cocoa, &c., are all also supplied, and several liqueurs, *e.g.*, creme de menthe, in penny glasses. For about 5*d*.-7*d*. one can get a good meal at these places; the weak point is that one gets too much carbohydrates (bread &c.) in proportion to the proteid (meat &c.).

A noticeable feature about Germany as a whole is the "disciplined" nature of the people. Each man attends to his own business, and does that thoroughly, with the result of great national efficiency. One does not see in Germany the "loafer" class that is only too prominent in London and other English towns; one may leave the station and walk through the town with a suit case without being pestered by men and lads wanting to carry it. The same is the case in America or Canada, but not in England or Ceylon.

On the German trains the conductor books one's seat. He takes your name, enters it, and turns round a label above your place, with a number upon it, and no one else is allowed to have that particular seat. A system somewhat like this is slowly coming in in England, but in America and Canada of course one may book seats days or weeks in advance, as at a theatre.

Every railroad official in Germany carries a pocket time-table, and can tell you the times of trains to and from any point. This is a system worthy of copying.

While on the subject of railroads, the Japanese system may be noticed. At every station there is a large board put up, with notices (in English and Japanese) of all the interesting places near the stations and the distance. Thus one might at Henaratgoda station put up:

Botanic Gardens	1 mile
Asgiriya temple	1 mile

and so on.

GUMS, RESINS, SAPS AND EXUDATIONS.

RUBBER AND ITS SUBSTITUTES.

(From the *Chemist and Druggist*, Vol. (LXXVI., No. 1562, January 1, 1910.)

The circular which was issued recently by the Synthetic Rubber Co., announcing the proposed voluntary winding-up, on the grounds that further expenditure was not justified, has given great satisfaction to dealers and brokers in rubber, although it may be said that in Mincing Lane the synthetic bogey never caused much apprehension, even though Professor Dunstan, at the British Association meeting in 1906, confidently predicted the synthetic production of rubber before the Association met again at York. At present there is still no likelihood of the prophecy coming true, but the commercial production is by no means an impossibility. It is interesting from this point of view to give a *résumé* of the many attempts, especially during the last decade, to make artificial rubber or prepare satisfactory substitutes for it. The only known actual synthesis of caoutchouc is that accomplished by Bouchardet and Tilden by polymerising isoprene (CH): (CH_2). (CH_2): (CH), which is itself one of the distillation-products of caoutchouc. Wallach and Tilden (1892) also showed that isoprene obtained from turpentine behaves similarly to that obtained in the destructive distilation of rubber. Kondakow, in 1902, prepared a substance closely resembling caoutchouc, by the action of light for a year on di-isopropenyl or methyl isoprene. A British patent granted in 1907 proposes to convert acetylene and ethylene into di-vinyl under the influence of a dull red heat, which latter product yields metyl di-vinyl or isoprene on treatment with methyl chloride. The isoprene is then to be condensed to rubber. Other processes have been patented on the assumption that coal tar contains polymers of isoprene or compounds convertible into such substances. Thus Seguin and Boussy de Sales patented in France during 1903 a process according to which tar (containing isomers of caoutchouc) is seeded with caoutchouc particles or treated with other appropriate ferment at 60° C. in an atmosphere of nitrogen. Later a method was patented of preparing the "ferment." To obtain this the "thick deposit" from a caoutchouc solution in benzine, kept at a temperature of 50° C. and exposed to daylight in a closed bottle, is re-dissolved and then precipitated again by alcohol. The precipitate is scattered over the surface of a mixture of coal tar and boric acid which is maintained at 50° C. in an atmosphere of oxygen. A brownish-grey powder is stated to be formed on the walls, and this is the "ferment" in an active form. Prior to the last process, Jasset (1902) stated in his specification that coal tar (4 parts) and boric acid (1 part), heated until the burning vapours were coloured green and then kept at 60° C. in a current of oxygen, yielded a brown highly elastic body to suitable solvents after drying on a water-bath. Phosphoric or iodic acid may replace boric acid. An American patent, by Dupont and Franklin (1903), gives a variation of the above, since the tar and boric acid are dissolved in alcohol, heated until vapours burning with green flame are evolved, then oxygen is passed through the mixture. Blum and Carpenter (French patent, 1909) propose to obtain a glutinous mass consisting of a hydrocarbon of the formula $(C_5H_8)_4$ by subjecting vegetable substances, such as peat, to fermentation at about 60° C., and simultaneously or subsequently to a reducing process. The enzyme is stated to be present in imperfectly formed caoutchouc, or an "enzyme which will produce alcohols of a series higher than the olefine series" may be used. The reducing agent is a nitrogenous compound, preferably the red substance resembling seed in red Upper Congo rubber, with the addition of mineral salts. In 1908 the same two patentees specified a process to produce "synthetic Para rubber" by treating with a nitrogenous derivative of irone, the mucilaginous mass containing a large percentage cf isoprene" produced from fermented peat, etc. The irone was stated in a subsequent patent to be obtained from roots of species of *Iris*. The irone is converted by chlorine into a hydrochloride, then by addition of a suitable substance, preferably an amide, into a nitrogenous compound. Protein-coagulating enzymes are known to occur in the latex of rubber-producing plants, but exactly in what form caoutchouc pre-exists is not known; but to produce artificial rubber from tar by a vclatile enzyme capable of growth does not accord with known facts.

Rubber substitutes have met with greater success since at present considerable difficulty is experienced in obtaining rubber goods free from substitutes. Their use as a cheapener is responsible for many of the defects to which rubber

articles are liable. The non-resistance of rubber substitutes to the action of potassium hydrate is the method used for the detection and estimation of substitutes. Among the multifarious substances proposed to be employed for diluting rubber the oxidation-products of drying-oils are the basis of the main modern class. Dry oxidation of a suitable fixed oil, usually linseed oil, is effected with manganese dioxide, etc., or in the wet process nitric acid is used, the object being to form elastic substances similar to linoxyn. Stiffeners such as resin, pitch, tar, acacia, tragacanth, and albuminoids such as gelatin or casein, may be added, as also "filling" materials including chalk, magnesia, silica, kaolin, zinc oxide, cork, sawdust, chopped feathers, and waste leather. The product is vulcanised in the usual manner, frequently with the addition of waste or regenerated rubber, and is then used for lower-grade goods. The elastic product yielded by heating nitrated castor oil to 130° C. for ten hours is the subject of a patent by the Velvril Co. Passing ozone through a mixture of castor oil containing colophony and sulphur is a variation of the oxidation process patented in America, the product being finally heated with sulphur chloride. Ditmar (1906), in his specification for a process for the removal of unvulcanised oil by means of solvents, states that the defects in substitutes are due mainly to its presence. Gelatin or glue, with or without admixture of glycerin, rendered insoluble by treatment with formaldehyde or chromic acid, gives another form of rubber substitute. The viscous masses obtained by heating carbohydrates such as sugar and starch, are the subjects of patents, as also elastic plastic masses stated to result from the action of acetylene and oxygen on a mixture of copper and nickel, the metals acting as catalyst. Rouxville (1906) filed a specification in France for producing caoutchouc, etc., from terpenes (turpentine), but did not complete the patent in England. The conclusion arrived at is that cheaper rubber of improved quality is more likely to be derived from increased production by recent rubber-plantations than by artificial production.

GUTTA-PERCHA CULTIVATION.

(From the *India Rubber Journal*, Vol. XXXVIII, No. 12, December, 1909.)

From a number of communications which have been received at this office, it would appear that the possibilities of cultivating gutta-percha is receiving a certain amount of attention in different quarters. The idea is not, of course, a new one; it occurred to Teysmann, of the Botanic Gardens, Java, in 1856, and was acted on by him in the same year, with the result that the Netherlands Indies Government have now a considerable area under this product.

In the "Sourabaya Handelsblad" some little time ago appeared an article on the subject in which attention was called to an alleged deficiency of seed-bearers in the Straits and F. M. S. Mr. H. N. Ridley, of the Botanic Gardens, Singapore, replied in a letter, which was at the same time an assurance that sufficient seeds were available in case of a demand springing up, and a denial that gutta-percha cultivation was commercially attractive.

In Singapore there are a large number of cultivated plants, and the trees may be found growing wild in parts of the Island, while in Penang there are many fine fruiting trees. Large areas in the F. M. S. have been found rich in this plant, and these, by a system of clearing the unnecessary vegetation and planting the blanks with seedlings, have been converted into extensive cultivations. Gutta percha does not, however, possess the importance as a commercial product which it did in the past, and in Mr. Ridley's opinion it is not likely to regain the position it then held. Thus, though its cultivation is by no means neglected in British Malaya, it has not been considered worth while to cultivate it so elaborately as at Tjepetir.

Dr. A. H. Berkout, who has contributed to the *India Rubber Journal* (April 6, 1908) an interesting article on the cultivation of gutta-percha in Java, agrees with Mr. Ridley as regards the inadvisability of private planters taking up the cultivation, at least until the problem of the preparation of leaf gutta has been solved. Palaqium gutta has been found the most satisfactory tree to plant, but the yield is low compared with that obtainable from Para rubber, etc., and the waiting period long. On the Government plantations it is calculated that the ultimate cost will amount to £25 per acre. Calculating a yield of 50 lb. per acre in alternate years—that obtained from some 23 year old trees near Buitenzorg—it will be seen that large profits cannot be looked for. Tapping in alternate years is necessary owing to the slow wound response.

A correspondent of the "Straits Times' takes a more optimistic view. In the first instance, he thinks, the statistical position of gutta-percha compares very

favourably with that of rubber, for whereas the output of rubber at the present rate of planting is bound to increase enormously year by year, the collection of really first-class gutta-percha, so called gutta mera, has not only not been progressing but has steadily declined during the last decade owing to the habit of the natives of destroying the trees for obtaining the gutta. That annihilation has been going on at such an alarming rate that the felling of trees is now prohibited in several countries. Moreover, it must be borne in mind that the best kinds of gutta trees only grow in a comparatively very narrow area, comprising parts of Borneo, Sumatra, Java and the Malay Peninsula, and that whatever old trees in larger numbers are left, occur only in places difficult of access. It should, he thinks, be further considered that submarine telegraph cables, in the construction of which for insulating purposes gutta-percha is principally used, will continue to be required for a good many years to come on account of the greater reliability and safety in working compared with the wireless systems, and that in addition to new cables to be laid, old ones have to be replaced. An idea of the quantity of gutta-percha required for this purpose is obtained if it is remembered that, as calculated by a living authority on gutta-percha, no less than 29,000,000 trees have been destroyed to provide gutta-percha necessary for the cables already laid all over the world. Supposing, asks the writer, only half these cables were to be relaid without taking into account new ones to be constructed, where are the trees from which the requisite genuine gutta-percha is to be obtained?

The idea of cultivating gutta trees, he continues, has so far not been carried out except to an insignificant extent, principally because the trees cannot be profitably tapped before 13-15 years, during which the capital invested would give no return. Moreover, the gutta obtained from leaves and twigs has hitherto had to be extracted by a chemical process which affected the properties of the gutta in such a manner as to make it practically unfit for cable requirements. This drawback has now been remedied, and there is every reason to believe that, at no distant date, leaf gutta will be in every way as good as tapped gutta. It will then be possible to get regular and handsome returns from gutta leaves, from trees four years old and upwards, which returns will be augmented by the profit from tapped gutta as soon as the trees attain an age of 13 years. However, even without relying on the leaf-product, investment in a gutta plantation pays well, considering that 15 year old trees, yielding best quality, fetch $10 to $20 per tree if retailed to the Malays for felling. The upkeep of an estate costs very little after the trees are a few years old; in fact, the trees seem to prefer surrounding jungle.

The writer when visiting the East last year made a special point of investigating the possibilities of this cultivation and of examining the trees then growing at Buitenzorg. At the best the growth was miserably poor. He then wrote:—

"I saw the trees which were planted on the 8th February, 1884; many of them were only about twenty-four inches in girth, though the giant of the block measured 5½ feet in circumference at a yard from the ground. The trees have been tapped on the single oblique and herring-bone systems, and also on the half circle horizontal plan. Every effort has been made to procure good yields from these old trees. The cuts have healed very badly, and the yield only averaged 89 grams per tree per annum. With gutta-percha out of fashion, a wait of fifteen to twenty years, and a yield of about one-fifth of a pound per annum, I do not see any reason why the Dutch Government should be envied. Even if the price of the raw product should show a big rise, it is doubtful whether the cultivation of palaqium will ever be as remunerative as *Hevea brasiliensis*. The Government Plantation is, according to information locally obtained, about 1,500 acres in extent; a block of the same size and age of Hevea would have placed the island of Java in quite a different position to-day."

That was in May, last year, and we still see no reason for altering the meaning of the notes then penned.

OILS AND FATS.

THE SOY BEAN.

(From the *Journal of the Board of Agriculture*, Vol. XVI., No. 9, December, 1909.)

The soy bean, which has recently come into prominence in this conntry as a feeding stuff, is a native of south-eastern Asia and has long been cultivated in China and Japan. It has also been introduced into India but is not very extensively grown.

Production in Northern China.—The beans which have been exported to the United Kingdom during the past year have come from Mancuhria through the ports of Dalny, Vladivostoc and Newchwang. There is no very precise information as to the area under cultivation within reach of the railways, but there is no doubt that the bean is largely grown and, given sufficient inducement, a considerable increase in the supply is likely to take place.

The total production of beans in Southern Manchuria, which is served by the ports of Dalny and Newchwang, is stated to have been 580,000 tons in 1907, and 830,000 tons in 1908, while in Northern Manchuria the Vice-Consul reports that the crop in 1908 probably amounted to 900,000 tons, and the prospects for the crop in 1909 indicate a yield larger possibly by 20 per cent. The beans from Northern Manchuria come through Vladivostoc. The spot prices in London on November 25th were reported to be about £7 10s. a ton for soy beans, and £6 2s. 6d. for soy bean cake. The Continental demand is large.

Composition of Soy Beans.—Yellow, green and black beans are grown in China, and there are varieties of these as well as brown soy beans. According to a number of analyses they usually contain about 35 to 40 per cent. of albuminoids and 10 per cent. or less of oil, but the composition varies according to their origin. The following are some recent analyses :—

	No. 1. Yellow per ct.	No. 2. Green per ct.	No. 3. Black per ct.	No. 4. Green per ct.	No. 5. Yellow per ct.	No. 6. Brown per ct.	No. 7. Yellow per ct.
Moisture ...	10·23	—	11·17	9·91	10·62	—	10·52
Ash ..	4·32	—	4·36	5·31	4·51	—	4·62
Oil ..	15·62	—	16·76	16·54	18·11	—	17·26
Albuminoids	37·54	39·75	40·46	41·17	37·07	35·42	36·05
Carbohydrates	27·27	22·30	21·45	22·81	24·46	24·58	26·16
Woody fibre ..	5·02	—	5·80	4·26	5·23	—	5·59

The analysis of sample No. 1 was made by Mr. S. H. Collins, M.Sc., lecturer in Agricultural Chemistry, Armstrong College, while samples 2 to 7 were analysed by Mr. E. S. Edie, M.A., B.Sc., Liverpool University. The first six were all Chinese beans, but No. 7 was grown in West Africa.

On arrival in this country the oil is extracted from the beans by pressure, and the residue forms the soy bean cake or meal used for feeding cattle. The proportion of oil left in the cake varies, and its value for fattening purposes will, of course, vary according to its composition in this and other respects. Much of the cake sold is guaranteed to contain 6 per cent. of oil and 40 per cent. of albuminoids; decorticated cotton cake usually contains 7 to 10 per cent. of oil and 45 per cent. of albuminoids, while the undecorticated cake contains 5 to 6 per cent. of oil and 24 per cent. of albuminoids.

Bean cake is also exported from Manchuria, and as handpresses are commonly used there, the proportion of oil remaining in the cake is higher. Analyses Nos. 1-3 in the following table are given by Mr. Acting Vice-Counsul Gordon in a report to the Foreign Office (*Annual Series*, No. 4372), as representing results obtained from Manchuria bean cake, while the remainder represent soy bean cake made in this country. Analysis No. 4, is by Mr. S. H. Collins; No. 5 by Professor Kinch of the Royal Agricultural College, Cirencester, and No. 6 by Mr. James Hendrick.

	No. 1. pr. ct.	No. 2. pr. ct.	No. 3. pr. ct.	No. 4. pr. ct.	No. 5. pr. ct.	No. 6. pr. ct.
Water..	17·38	16·90	19·19	13·31	13·0	11·3
Oily substances ..	9·76	9·70	9·18	6·00	7·0	8·1
Albuminous substances..	40·98	41·67	45·00	44·37	42·5	44·9
Carbohydrates ..	20·73	20·64	15·62	25·04	37·5	23·7
Fibre, vegetable ..	6·65	6·64	6·23	3·90	5·0	6·2
Ash	4·50	4·45	4·78	7·38	5·0	6·8

Some of the cake and cake-meal which is being sold has had the oil extracted from it by means of a solvent, instead of by pressure. In such cases only 1½ to 2½ per cent. of oil remains.

Feeding Experiments with Soy Bean Cake.—Up to the present very few experiments on systematic lines have been made with this cake, though it has been extensively used for feeding purposes by farmers.

One experiment, reported by Professor Gilchrist, of Armstrong College, was carried out at the Cumberland and Westmorland Farm School, and was intended to test the comparative feeding value of soy bean cake and decorticated cotton cake. Three cows and three heifers, after their first calf, were selected in February, 1909. They were

all at an early stage of their lactation period, and as the milk naturally declined in quantity as the trial progressed, it was decided to feed soy bean cake during the first and last three weeks and decorticated cotton cake during the middle six weeks. Each cow received daily 40 lb. swedes or 42 lb. mangolds, 14 lb. hay, 7 lb. oat straw, 4 lb, crushed oats, and 4 lb. soy bean cake or 4 lb. decorticated cotton cake.

As regards milk production, there was a slight advantage in favour of the soy bean cake, but it was so small that the two cakes were considered to be equal in this respect. Both foods also gave similar results as regards the fat content of the milk. The cows gained rather more in weight while they were receiving the soy bean cake than they did on the decorticated cotton cake.

An experiment on similar lines was conducted at the Royal Agricultural College, Cirencester. Six cows were seclected from the College herd, and divided into two lots of three each, care being taken that the age, period of lactation, and quantities of milk per day were as nearly equal as possible. The cows were turned out to grass on April 5th, and the experiment lasted from April 12th to May 9th. The daily rations were 35 lb. pulped mangolds, 6—8 lb. chaff, 2 lb. ground oats, 1 lb. bran, and a small allowance of hay. Lot 1 received, in addition, 4 lb. soy bean cake, and lot 2, 4 lb. decorticated cotton cake; the bean cake contained 6 per cent. of oil and 40 per cent. of albuminoids and cost £6 10s per ton, while the cotton cake contained 8 per cent. of oil and 34 per cent. of albuminoids, and cost £7 10s. per ton.

The yield of milk appeared to be little affected by the kind of cake used. The percentage of butter-fat in the case of the bean cake remained almost constant, a slight increase, if anything being noticed; with the decorticated cotton cake the percentage of butter-fat had a tendency to fall.

The butter produced by the bean cake was of a soft, oily nature and quickly churned, but it yielded well. It was, however, of a decidedly paler colour and somewhat inferior flavour as compared with that from cotton cake. The butter produced by the decorticated cotton cake was hard, and took a longer time to churn. The yield, however, was not so good as from the bean cake. No difference in laxative effect or otherwise was observed in the two cakes.

Another experiment on a small scale was carried out at the Harper Adams Agricultural College, with two rather delicate heifers, to test the question of the possibility of this cake having any deterimental effect on animals. Increasing quantities up to 7 lb. a day were given to one animal without any ill-effects and the cake was eaten with relish. The other heifer was fed on a patent cake, and then a sudden change made to soy bean cake, and in this case also no difference was observed.

An experiment carried out in Germany, at the Agricultural Institute at Bonn, is reported in the *Deutche Landwirtschaftliche Presse* (22nd and 26th May, 1900) in which soy bean cake was compared with linseed cake for feeding cows. The experiment was of a very exhaustive character, but only included three cows, which were fed for a fortnight at a time on linseed cake, soy bean cake, and again on linseed cake. The results showed little difference as the result of the feeding, and the conclusion arrived at was that soy bean cake was a quite satisfactory food for cows.

Use of Soy Bean Cake for Feeding.—The foregoing experiments and the analyses which have been made, show that this cake may be regarded as a useful feeding stuff when given to stock in suitable quantities and in combination with other foods. It is, however, rich in albuminoids, and if not fed judiciously may give rise to digestive troubles. As the analyses given above show, it approaches decorticated cotton cake in composition, and should be fed in the same way as that cake with roots, hay and straw.

Several cases have been reported to the Board in which stock fed on soy beans or cake have become ill and died, and investigation into these cases is now in progress. At present there is no evidence to show that cake from pure soy beans (*Glycine hispida*), or the beans themselves, if fed to animals in suitable quantities, would cause undesirable results. It is possible that the accidents reported have been due to an admixture with the soy beans of some other feeding material possessing poisonous properties.

Soy beans have been cultivated for a number of years in the United States and are regarded as a useful fodder crop. The plant is grown, not only for the beans, but also for hay, while it is, perhaps, more commonly used for green forage. Some information as to their cultivation was given in this *Journal*, May, 1909, p. 128, and further information on this point will be found in *Farmers' Bulletin*, No. 372, of the United States Department of Agriculture.

FIBRES.

SELECTION OF COTTON VARIETIES FOR UNIFORMITY.

(From the *Agricultural News*, Vol. VIII., No. 198, November 27, 1909.)

It is a well-known fact that the introduction of a good variety of cotton into a locality often leads to the exhibition of a large amount of diversity among the plants, and that, in addition, they may appear to possess very different characteristics from those presented by them in their old surroundings. This effect has been shown, in Bulletin No. 159 of the Bureau of Plant Industry of the United States Department of Agriculture, to be different from other types of variation, such as the ordinary fluctuating differences, changes due to accommodation, direct effects of environment, and diversity due to hybridization, and is there termed a 'new-place effect.' The remedy suggested is selection for 'local adjustment,' that is selection for uniformity by rejecting all lines of descent in which changes from the best type occur; it is a natural concomitant of selection for improvement, and it seems that any properly organized scheme for this would automatically include it; thus its consideration only forms another argument for the continuous practice of selection. As many of the conclusions reached in the above-mentioned bulletin are applicable to West Indian conditions, they are given here:—

The growing of a variety of cotton in a new locality is likely to bring about a distinct reduction in the yield, as well as in the quality, of the fibre. This deterioration has been found to be connected with an increase of diversity among the individual plants. Even when a carefully selected, uniform stock is used for the experiment, a much greater amount of diversity may appear in a new place than when the same stock is grown under the accustomed conditions of the previous locality, where the variety was improved by selection.

The diversity that reappears in the first season, when a variety of cotton is grown in a new place, can be greatly reduced in later seasons by selecting seeds from the plants whose characteristics have been least disturbed by the transfer to the new place—those that are the most fertile and have the best lint. This process of selection to restore the uniformity of a variety in a new place is called local adjustment.

Selection for local adjustment is distinct in objects and methods from breeding for improvement or for originating new varieties. The object of local adjustment is to preserve varieties already existing and to guard them against recurrence of diversity. Practical advantages can be secured by simple selection for local adjustment without the separate testing of individual lines of descent, as is required in breeding for improvement of a variety, or when new breeds are to be developed.

The phenomena of local adjustment are of general scientific interest as illustrating one of the influences of external conditions upon the expression of characters in organisms. The recurrence of diversity in a previously uniform variety serves with other facts to show that ancestral diversities continue to be inherited, even when their expression is avoided by efficient selection. That changes of conditions can induce a return to diversity shows that the environment is able to influence the expression of characters, and that its influence is not limited to characters that vary directly and regularly with changes of environment.

Apart from the effects of conditions which limit or inhibit the growth of the plants, two kinds of changes are found to follow transfer to new places: (1) Changes of accommodation to different conditions, and (2) diversification, or loss of uniformity. Changes of accommodation do not directly increase diversity, for they are shared by all the individuals, but changes of accommodation are often accompanied by changes of other characters which render the individual plants much more unlike than before.

It is not necessary to believe that the diverse characteristics that appear in the new place come into the plants from the external environment, or that they represent direct effects of the environment upon the plants. It is more reasonable to suppose that new conditions induce diversity in an indirect manner by disturbing the process of heredity, and thus allowing ancestral characters that had been transmitted in latent form to return to expression, or characters previously expressed to become latent. Recurrence of diversity may be quite independent of hybridization, although some of the results are very similar.

The phenomenon of local adjustment only strengthens the many other

evidences that the uniformity of a variety of cultivated plants can be maintained only by persistent and vigilant selection. The decrease in the agricultural value of a variety that results from a return to diversity is as real and important as the agricultural improvement that is made when diversity is reduced by selection.

The facts of local adjustment go far to explain the apparently capricious behaviour of cotton varieties in comparative tests, the same varieties often standing in entirely different relations to one another in different seasons. It becomes evident that the adaptation of a variety to a new place cannot be fairly tested in a single season. Not until a new stock has passed through the process of local adjustment and returned to a normal degree of uniformity can the extent of its adaptation to the new place be definitely ascertained.

The facts of local adjustment indicate that our superior varieties may be found adapted to much wider regions than they now occupy. Varieties of real value should have their range extended through local adjustment, instead of being discarded because they fail to show their superiority in the first season. The wider extension of a few superior types of cotton would make it possible to abandon many local varieties, and would constitute an important step in the progress of the cotton industry. Greater uniformity in the crop over large areas would increase its commercial value, and simplify commercial problems of grading and marketing.

MADRAS SISAL AND OTHER FIBRES.

(From the *Indian Agriculturist*, Vol. XXXIV., No. 7, July, 1909.)

That there are possibilities in the cultivation in India of the aloe, or agave as it is known to botanists, for the fibre it yields, is being more widely recognised day by day. Last week our Planting Correspondent noticed the increased attention which the "Muir" Companies are paying to the plant, and by this Mail we have received a copy of the last Bulletin of the Imperial Institute, which contains an account of the examination and valuation of three samples of aloe fibre sent Home by the Director of Agriculture, Madras. One of these, taken from the *Agave rigida*, or *Sisal fibre* as it is known to the trade, is described as of excellent quality, of good lustre, varying in colour from nearly white to pale buff, of very good strength and 3 ft. long. It was valued by experts at from £36 to £38 per ton, with Mexican "Sisal" selling at £34 per ton, and it is stated that its value would have been enhanced if the colour had been more even and nearly white. A sample of fibre from the *Agave americana*, or railway aloe, was extracted from leaves of the age of six years and was of uneven quality. One bundle consisted principally of nearly white, lustrous fibre, which was fairly well cleaned, whereas the rest of the fibre was somewhat gummy, of poor lustre, and had a quantity of greenish pulp adhering to it. The strength was uneven, but mostly good, and the length varied from 2 to 3 feet, whereas a rope-making fibre should be at least 3 feet in length. The greenish colour and the gummy and pulpy nature of the bulk of the sample were said to be due to insufficient washing. This fibre was inferior to the sample of *Agave rigida*, and was valued at £27 to £28 per ton, with Mexican "Sisal" at £34 per ton. The sample of *Furcrœa* fibre, which was also extracted from leaves of the age of six years, consisted of fairly well-cleaned fibre, varying from buff to nearly white, of fair lustre, but a little gummy and stiff. It was of uneven strength, and from 2 to 3 feet long. This sample, according to the Report, would have been more valuable if it had been more even in colour and less gummy and of a more suitable length for rope-making purpose. It was valued by the experts at from £26 to £27 per ton.

The cultivation of "Sisal" fibre is said to be going ahead enormously in German East Africa and, as is well known, it has converted certain islands in the West Indies, such as the Bahamas, and certain districts of Mexico, which were before practically wide wastes, into valuable profit-yielding estates. There are many who believe that the "Sisal" aloe is capable of achieving equally remarkable results in India. Some years ago Dr. Mann, at that time Scientific Officer to the Indian Tea Association, and Mr. Hunter published a most interesting pamphlet on the subject, and more recently Dr. Mann has described his later experience with the product in the columns of the *Agricultural Journal of India*. The profits likely to be obtained depend, of course, on the price of the fibre, which has fluctuated a good deal in the past, but the cost of production should not vary very much. Dr. Mann estimated that the cost of growing "Sisal" fibre on an estate of an economical size in Assam would amount to from £14 to £15 per ton including freight and other charges

to London, and that an acre should yield two tons. If these figures are correct, and there is no reason to doubt them, the profit when prices range at anything over £30 a ton for "Sisal" fibre should be very considerable.

Mention is also made of a sample of Manila hemp (*Musa textilis*,) grown in the Government Experimental Garden, Kullar, on the Nilgiris, at an elevation of 1,300 ft., and forwarded by the Agri-Horticultural Society, Madras. It consisted of a well-prepared fibre of pale buff colour and fair lustre, and was not so harsh as ordinary Manila hemp, but rather resembled plantain or banana fibre in general character. It was reported to be inferior to ordinary Manila hemp and to be more like plantain fibre. The fibre, being rather soft, was regarded as well adapted for the manufacture of binder twine, and was valued at about £23 to £24 per ton. A more interesting investigation was that of a sample of kapok—the seed-floss of *Eriodendron anfractuosum*, a common tree in Madras—which was collected by the Tahsildar of Virddhachalam, in South Arcot. The kapok is described as clean, of an even, light brown colour, very lustrous, resilient, soft and silky. The brokers to whom it was submitted for valuation considered it to be much superior to ordinary Indian or Ceylon varieties, and, in fact, fully equal to good Java kapok. Such material, they stated, would be readily bought by manufacturers, but an exact valuation was difficult to give, they said, as the same description of floss had not been sold on the London market for about two years. They were of opinion, however, that it would be saleable at about 4½*d.* per lb. in the condition of the sample, which contained a quantity of seeds and occasional fragments of the capsules. If free from these impurities they thought that the kapok would probably fetch 6*d.* per lb. It is interesting to note that samples of this material, owing to its superior quality, have been placed on exhibition in the Indian collections of the Imperial Institute.

INDIAN PAPER INDUSTRY.

(From the *Indian Trade Journal*, Vol. XV., No. 189, November 11, 1909.)

Many reasons have been assigned from time to time to account for the practical failure of the paper industry in this country. One of the latest is contained in a Monograph on Paper Making in the Bombay Presidency by Mr. R. T. F. Kirk, I. C. S., who says:—

"For various reasons paper mills in this country, and especially in the Bombay Presidency, find it difficult to make headway against the competition of foreign goods imported from England, America, Austria and Germany. In the first place, materials of good and equal quality or of any one particular quality are not easily obtained. Here, the paper-maker is forced to be a rag-dealer, with his own collecting agents in the principal towns. In Europe, rag-collecting is a separate industry, and the rags are carefully sorted by skilled labour before they are delivered to the mill. Numerous different qualities and kinds are fixed by trade custom, and a supply of any one of them is instantly available to order. In India, on the other hand, the rags are sorted at the mills, and are found to contain a greater quantity of old, dirty, worn and useless material. The Deccan Paper Mills calculate that out of 100 tons of "dirty-white" rags received from their agents 40 tons are sorted out as useless, leaving 60 tons as available. Of this, 12½ per cent. is lost in dusting and chopping, leaving 52 tons. Of this, 40 per cent. is lost in bleaching and boiling, leaving 32 tons. That is, out of 60 tons of rags only 32 are available after treatment, showing an approximate loss of 50 per cent. From the table given on page 19 of Sindall's *Paper Technology*, the highest percentage of loss on rags during the treatment is 36, which is the figure for unbleached linen. In India the rags are commonly of cotton, and Sindall gives a percentage loss of about 20 for cottons. The loss as calculated by the Deccan Mills is at least twice as great.

The supply of rags is entirely uncertain, and there is often a corresponding uncertainty in the quality of the paper, due to the use of substitutes, or to uneven porportions in the mixture of materials. In order to supplement the rags the mill uses a kind of grass known as *sabai* or *babai* grass in Bengal, where it grows in abundance.

The company laments that coal is not obtained so easily in Poona as in Bengal. From 2 to 2½ tons of coal are required per ton of finished paper. The prices quoted are Rs. 4-8 per ton in Bengal, with Rs. 11 freight to Poona. If obtained from Singareni in the Nizam's territory, the cheapest is Rs. 8 per ton, with Rs. 8 as freight.

Paper-making is not a flourishing industry in the Bombay Presidency. Either no person with sufficient capital or ability or enterprise has yet come forward to compete with foreign makers on their own lines, or the difficulties of situation and supply are too serious to overcome."

DRUGS AND MEDICINAL PLANTS.

NATURAL AND ARTIFICIAL CAMPHOR.

AN IMPORTANT LECTURE.

(From the *Indian Forester*, Vol, XXXV., No. 12, December, 1909.)

At the Congress of Applied Chemistry on 20th May, 1909, Prof. Haller, whose lecture on the Chemistry of Camphor preceded the above, said that the extended use of camphor dated from the time when celluloid, of which it formed a constituent part, became the object of intensive and increasing manufacture. The important part it played in the industry of this plastic material, and the special qualities which it lent to the introcellulose with which it was incorporated, rendered it valuable for other purposes. It was used for the manufacture of pegamoid, a new substitute for leather, and entered into the composition of certain smokeless powders either as such or in the form of borneol. They were aware that camphor was prepared by distillation with steam from the wood of the camphor laurel, a fine tree which grew in Japan, in Formosa, were it still formed immense virgin forests more and more difficult of access, in various Japanese Islands, and also in several districts of Central China. Since 1899 Japan had secured the monopoly of the camphor crop throughout its territory and in Formosa. According to statistics published in a Japanese journal and reproduced by the *Chemist and Druggist*, the amount of camphor exported from Japan increased from 280.892 kilos, valued at 200,452f., in 1868, to 1,834,594 kilos, valued at 130,691,831f., in 1907; and during the same time the price increased from 69f. to 708f, per 100 kilos. In spite of an increasing production in China it appeared from the statistical evidence that the aggregate *output of camphor was not increasing*, and that they must rather expect to see it gradually diminish. And, since the demand on the contrary went on increasing, it was easy to understand the high prices reached, which had driven the camphor industry to make up the deficiency in the production of the natural substance.

It was about 1905 that the first attempts to supplement the supply by artificial camphor came into view. All the processes of manufacture started with pinene, a carbon compound found in the essential oil of turpentine. The latter was obtained by steam distillation from the resin yielded by various conifers growing in the forests of the temperate zone. The principal countries of origin were, in order of importance, the United States, France, Russia, the Central European States, Germany and Austria. In recent years Spain had also contributed to the world's markets. The French essence produced from the sea pine was considered to hold the first place in respect of quality; that of the United States, from pitch-pine, was less valued; and those of Russia and Germany, obtained chiefly from the *Pinus silvestris*, were of inferior quality. The question of industrial camphor depended as much on the price of a good essence as on the methods employed. The efforts expended on the problem had resulted in no new fact or original discovery. The numerous methods employed were only improvements or variants of reactions previously known. They might be divided into two large groups according to whether the essence was first converted into hydrochlorate of pinene, or was submitted direct to the action of organic acids. The high prices of camphor, to which they owed the evolution of the new industry, had only been temporary, for reasons which it was extremely difficult to discover. Only those establishments which in the fortunate period of high prices found themselves in possession of an economical and thoroughly efficient process, and were in a position to organise a prompt supply in response to the demand of the moment had been able to take advantage of the remunerative prices and recover the cost of installation. He should add that the camphor which they produced apart from its optical inactivity, possessed in all respects the same properties as natural camphor when it was sufficiently refined. Comparisons had been made between the camphor industry and the alizarine and indigotine industries, and some enthusiastic spirits had not been afraid to celebrate this new triumph of industrial science. With regard to the two substances mentioned, science and industry had incontestably got the better of nature. The cultivation of madder had completely disappeared from the departments of the Midi in France, and artificial indigo was on the way to ruin the immense and numerous plantations of India, Java and Guatemala. Would the same thing happen with camphor? It would be rash to say so, for various reasons which he

enumerated. The conditions were very different both with regard to the supply of the natural product, the cultivation of which had been freshly stimulated, and with regard to the fundamental substance used in producing artificial camphor, namely, the essence of turpentine, the supply of which was limited and the price fluctuating. For these and other reasons the future of the camphor industry was uncertain.

INDIAN TOBACCO TRADE.

BY THE AMERICAN CONSUL AT BOMBAY.

(From the *Indian Agriculturist*, Vol. XXXIV., No. 11, November 1, 1909.)

That excellent tobacco can be grown in India is not denied by those who have given close attention to this particular subject, says the *Indian Trade Journal*. There is scarcely a village throughout the length and breadth of the country that has not its tobacco patch for local consumption or export. But the reason why really good Indian tobacco leaf is not more in evidence on a commercial scale probably is that there are few crops which demand more care, skill and sound judgment on the part of the producer, if marketable leaf of good quality is the object in view. It is to be feared, however, that the average cultivator is not enamoured of troublesome crops, even though they may ultimately prove to be paying ones. He likes something easy, and he is hardly to be blamed for that. But tobacco is not only a difficult crop to grow; it is also a risky one, unless every possible precaution is taken. Elaborate experiments have proved that the tobacco plant is very sensitive to the surroundings under which it is forced to grow. Its physical character, as well as its composition, are greatly influenced by soil, climate, manures and the care or neglect which it receives at the hands of the grower.

But tobacco is claiming a good deal more attention in India just now than was the case only a short time ago. The internal demand for it is enormous and tends to keep pace with the increase in population, as practically all the people smoke from a very early age. To meet this demand there are over a million acres under tobacco in British India and Native States, which produce an annual crop of an estimated value of £5,000,000. But, unfortunately, Indian tobacco is chiefly grown from inferior plants and is cured in a very primitive style. Generally speaking, it is very crude tobacco, which; however, seems to be good enough for the manufacture of the native cigarette or *biri*, which is sold at the surprisingly low price of ten annas, or less, per thousand; and for export to Burma to be mixed with other tobacco and made into what are known as Burma cheroots—a rank sort of cigar which, nevertheless, finds a ready market even among Europeans who have acquired the necessary taste. But the bulk of the Indian tobacco crop is not nearly up to the standard required for export to European countries, in most of which, however, a keen demand exists for first-class leaf; nor is it adequate to meet all requirements, for our imports of tobacco in various forms in the official year 1908-09 amounted in value to Rs. 79·41 lakhs. These imports largely represent cigarettes which are used by the fairly well-to-do classes, but for the manufacture of which suitable tobacco is not available in sufficient quantities. A start has been made in Bengal to meet this cigarette want by manufacturing this article on a large scale by modern machinery, the company, which is a European one, guarding itself to a large extent by growing its own tobacco. Now that a commencement on a large scale has been made, this industry is fairly certain to expand, particularly so as it is believed to be a reasonably profitable one; and all that is required to give it an immediate impetus is the cultivation of a better class of tobacco plant, associated with the introduction of up-to-date methods of curing.

As to the first of these requisites, the experiment now being carried out at Pusa with various varieties of tobacco plants should indicate the best kind for exploitation in this country; and, as to the second, what would seem to be required is a sort of central curing factory in certain tobacco tracts, such factories to be controlled by experts who know their business thoroughly and who have had long experience in such factories in America—the home of the tobacco plant and the country in which the growth and manufacture of tobacco have been brought to the highest pitch. For the climate of India is decidedly hostile to first-class tobacco curing, and is probably the greatest stumbling-block to the onward march of the Indian tobacco trade. In most countries where tobacco is largely grown the climate seems to be exactly tempered to the requirements necessary for good curing. That is to say, there is a warm, humid atmosphere giving the correct amount of heat and moisture by night and day, and the result is that the tobacco is cured in the best possible manner under what are

actually natural conditions. According to Mr. Bernard Coventry, who has given this matter careful consideration, the natural conditions in India are, as a rule, positively hostile to good curing, for the climate is too dry and the fermentative changes required do not take place. Hence the necessity we have suggested for properly equipped curing factories in which artificial means could be effectively introduced to obtain the necessary conditions of combined heat and moisture, and hence also the necessity for well-trained experts. These factories could, of course, form part of the ordinary tobacco manufactory, or could exist as separate units, purchasing the raw material from the surrounding growers and disposing of the finished article as might be most advantageous. In other words, they would be purely and simply tobacco curers in a country where an undoubted demand exists for properly cured tobacco.

If something on the lines suggested were done, there can be little doubt that the day would be hastened when India will, as she seems destined to do eventually, take her proper place and march with the great tobacco-producing countries of the world.

We are led to these remarks by a perusal of an instructive pamphlet recently issued by the United States Department of Agriculture, entitled *Principles and Practical Methods of Curing Tobacco*—Bulletin No. 143. In this work are contained the impressions and experience of Mr. W. W. Garner, Government Physiologist, in connection with official tobacco investigations, who discusses this, to India, at all events, very important question from practically every point of view, and introduces illustrations where necessary to keep his meaning clear. A copy of the Bulletin may be seen at this office, or may be obtained through any bookseller from the Government Printing Office, Washington, United States, at a total cost of a few annas.

The American Consul at Bombay in a report on tobacco trade in India says:—The British-American Tobacco Company practically controls the import trade of this commodity in India. The few local independent manufacturers find it very difficult to keep their businesses going with such strong opposition. There is a large import of cigarettes solely under its control. It has a factory at Monghyr, in Bengal, and has purchased land upon which it grows its own tobacco. The manufacture of tobacco is a promising industry in India. The natives smoke from early youth, and the tendency is toward the abandonment of the clumsy "hukka" in favour of cigars and cigarettes. According to official statistics the area under tobacco cultivation in India is about 1,700 square miles, more than half of which is in Bengal. The bulk of the leaf is exported to foreign countries in a crudely cured condition or is sent to Burma to be mixed with locally-grown tobacco and made into cigars. The imports of tobacco into India, however, exceed the exports, due mainly to the large import of cheap cigarettes. The prevalence of cigarette smoking is very noticeable in Bombay and other large towns. The cigarettes are sold at a price which brings them within the reach of all and creates a demand, for in the case of articles of popular consumption cheapness is in India the first consideration. However, in spite of these large importations, the Indian cigarette locally known as "biri" more than holds its own, except perhaps in the seaport towns where no inland freight has been paid upon the imported article. The cheapness of the "biri" is amazing, a thousand of them being sold for 20 cents and even less, notwithstanding the tobacco for their manufacture is sometimes brought from Madras and Assam, but the wages paid are only a little over half a cent for rolling 100 cigarettes. The Indian cigar industry is an expanding one and Indian manufactures are now exported to all parts of the world, but the quality of both the Indian cigar and Burma cheroot is very variable, due to the uneven quality of the tobacco. The Government has made repeated efforts to improve the culture, but owing to the conservatism of cultivators no success has been attained. The method of curing is also crude. The process is not under control and it is frequently carried too far with the result that the aromatic properties are dissipated, and an objectionable pungent mass is left. For wrappers the Indian cigar manufacturers use imported leaf, which may either be Sumatra or Java, and for fillers native-grown tobaccos are used.

JAVA CINCHONA.

(From the *Chemist and Druggist*, Vol. LXXVI., No. 563, January 8, 1910.)

In our issue of December 25 (p. 965) we gave an account of the proceedings at a recent meeting of the Preanger Cinchona Board, at which it was decided to issue a circular to cinchona-planters in Java, calling attention to the present position of the proposed Cinchona Syndi-

cate and the inimical attitude of the Bandong Quinine Factory thereto. According to the current number of the "Java Bode," this circular has now been issued. It reviews the recent history of the cinchona-market, pointing out that, owing to over-production, the price of bark has fallen steadily for many years. This fall in price was continuous until the opening of the Bandong factory, which at first worked in opposition to European and American quinine-makers, and bought bark from planters at a fixed and remunerative price. In recent years, however, the Directors of the factory have found that, owing to the low price of bark and the great popularity of their quinine tablets in the East, they are in a position to make huge profits, and they have disregarded the interest of planters more and more, and this attitude has finally culminated in their refusal to join the proposed syndicate, which has for its main object the maintenance of a minimum price of six cents per unit for bark. The Bond proposes that, if this attitude is persisted in by the Bandong factory, planters should refuse to sell bark to it, and that, if necessary, they should start a new factory of their own in Java. It now appears that since this circular was issued to planters, Heer van Leersum, the Director of the Government Cinchona Plantations in Java, has received a letter from the factory directors. The contents of this letter he has refused to make public, on the ground that it is an official document; but it is believed that the letter indicates that the directors are more favourably disposed towards the proposed syndicate than has been generally supposed. The possibility of raising the price of bark by joint action is not the only problem agitating planters in Java. We referred briefly in our issues of October 16 (p. 625) and November 13 (p. 571) to the lack of uniformity in results obtained by well-known bark-analysts, and this matter is discussed by Heer van Riemsdijk in a letter published in "De Indische Mercuur" of December 21 last. In the course of this he gives data showing how important this question is from a planter's point of view. Recently he consigned a parcel of 10,100 kilos of bark to the Bandong factory. Samples of this bark were analysed by van Ketel, who returned 8·54 per cent. quinine. A control analysis by Moens and van der Sleen showed 9·84 per cent. quinine. The factory analysis gave only 8·09 per cent. of alkaloid, while van Leersum, who was called in to arbitrate, found 8·1 per cent. In a second similar parcel van Ketel found 9·50 per cent., Moens and van der Sleen returned 9·81 per cent., while the factory and van Leersum reported 8·71 per cent. Heer van Riemsdijk produces each year about 360,000 kilos of bark, and he calculates that if van Ketel's figures are correct, he loses about 18,000 florins annually, while if Moens and van der Sleen's results are taken, his loss is about 39,600 florins. Commenting on van Gorkom's statement that no analyses of cinchona are published in the London market, Heer van Riemsdijk states that British quinine-makers buy bark on their own analyses, but these appear to be satisfactory to brokers and planters, since no complaints appear to be made. Van Gorkom, referring to this letter in the same journal, says he is in agreement with Heer van Riemsdijk on the main question of the need for a standard method of analysis, but doubts if this will be arrived at by the method of offering a prize, which is the plan adopted by the Preanger Cinchona Bond on Heer van Reimsdijk's suggestions; and adds that it would be interesting to hear what the private analysts to whom Heer van Riemsdijk sent samples of his barks have to say on the general question of methods of analysis.

EDIBLE PRODUCTS.

CACAO CULTURE IN GERMAN SAMOA.

ROBERT LOUIS STEVENSON'S INTEREST IN THE INDUSTRY.

(From the *Tropical Life*, Vol. V., No. 12, December, 1909.)

Previous to the hoisting of the German flag in Western Samoa some small areas of cacao had been set out, but the commercial production of the bean had not so far been worthy of record. During the last year of his life, Stevenson was greatly interested in this culture, and occasionally for exercise, or possibly for mere change, he would join his native boys and weed away until his weak frame told him he had gone far enough. As was expected at the time, his ideas of cacao culture were radically wrong, and the considerable area which he had set out came to no good end, very few of the plants surviving to this day. This experience came also to

others who sought, against all precedent, to accomplish results nowhere else attainable.

It has now transpired that though Samoa unquestionably produces cacao of the very highest value, and that it occasionally yields crops almost unbelievable in profusion, it still takes quite as long in that country to bring a plantation into the paying stage as it does elsewhere; and all of the old calculations that cacao would pay expenses in the fourth year and yield an enormous profit in the fifth year and thereafter are hopelessly wrong in practice. Instances of success have been known, but general practice proves that a plantation which is paying its expenses in the fifth year, and which netts from its crop from $100 to $125 per acre thereafter, is a good average plantation.

Usually, besides the length of time necessary for these results, it has cost the proprietor about $200 per acre to carry his plantation along to the paying stage. This money has gone out in the shape of wages to employés, food for them, houses, horses, wagons, and tools. Cacao properties, when in bearing, are difficult to buy, as owners, being sure of a fine revenue running for many years and with light expense, are unwilling to part with them. Probably $500 or $600 per acre would be a fair price for such properties, but so far no plantations in good working order have been disposed of; for although sellers are scarce enough, buyers do not appear in force either.

When a land selection has been made, the planter usually contracts with either Rotumah natives, Samoans, or Nieueans, to fell the bush and lop the branches of the fallen trees. The timber is allowed to remain prostrate for about six weeks, when the planter lines up his Chinese or other labour, and with light axes and heavy knives they cut off the branches and pile them about the stumps and heavy stems for burning. The usual practice is to cut and pile all day, and after 5 p.m. several labourers with torches set fire to the many piles which have been made, and these burn throughout the night much better than they would do during the heat of the day. Besides, when the labourers set to work on the following morning the smoke has disappeared and the field is clear for working. When the whole field has thus been burnt over once, the labourers are lined up again in the original positions, and the half-burned faggots are collected and placed about the stumps of those trees which exhibit signs of sending out shoots. Some varieties are very persistent, and a third and often a fourth burning is needed to kill them. Though the land thus roughly cleared is covered with the stems of forest giants, and great stumps stand up in all directions, the planter looks upon his clearing work as being nearly over. He now lays off the tract for his cacao, staking off the plant positions 12 ft. × 12 ft. or 15 ft. × 15 ft., as he decides upon, and holes are dug about 15 in. in diameter and 2 ft. deep, the extracted earth being placed on one side to sweeten for a time. Meanwhile, the whole field has grown green with millions of mummy apples and other spontaneous growths of vine or weed. Within a month after the last burning the property has to be weeded, part of the thick-growing mummy apples being allowed to survive to act as shade for the young cacao. Plants about 8 in. high are now brought from the nurseries and set out, and it is often that the shades of coconut branches or other materials are needed to protect them from the fierce rays of the sun, which are hottest during the intervals of the rainy season.

Within four months the mummy apples have grown to the height of 6 ft. or 7 ft., and they act as a good temporary shade, helping also to keep down weeds, which of all things cause the greatest amount of labour. A permanent shade, known as the dadap, is generally planted and spaced about 70 ft. apart. These trees grow much faster than the cacao, and serve to protect it from both sun and wind. The first pruning takes place in the second year, and harmful suckers must be kept down at all times. The young plants are hardy, and in three years are generally 5 ft. or 6 ft. high, often producing fruit and always producing blossoms. They are not at this time subject to any serious diseases, though occasionally one will die from attacks of fungus or white ants.

In the fifth year the plant endeavours to bear a heavy crop, and under usual seasonable conditions it succeeds in so doing; but the trees have not really reached their maturity until they are seven or eight years old, when their stems are about 10 in. in diameter, and the trees from 15 ft. to 20 ft. high. At this time they shade the ground beneath them to such an extent that neither weeds nor grass will grow. No further attention is required beyond keeping down the suckers which occasionally appear, and harvesting the crop.

Cacao in Samoa has no determinable season, and it is in fruit most of the year round, and owners of plantations often produce beans during every month. Crops up to 1,800 lb. of cured cacao beans are sometimes gathered from good acres during the year, but the average yield seems to be about 750 lb., worth locally at this time (May, 1908) about 17 cents per lb., or, say, $125 per acre. Of this fully $100 are profit.

Cacao in Samoa has a number of enemies which have to be fought, but experience seems to minimize those disadvantages which at one time were thought to be highly destructive. In fact it was feared that canker might destroy the industry. But a proper treatment has been found, and canker has quite disappeared from plantations once badly infected. This fungus seldom attacks trees which are less than five years old, and formerly it was usually fatal. With the present cure it may be eliminated at once; a second or third application is always successful if the parasite is discovered in time and the weather is not too wet: otherwise the canker is difficult to attack successfully. White ants entering the plant from the roots never manifest their presence until the trees are practically killed; fortunately their attacks are comparatively rare, not more than a quarter of 1 per cent. (·25) of the planted trees ever being infected. At one time rats and mice were exceedingly destructive, as they eat into the ripening pods in order to get the succulent fibrous connections between the seeds, and thus spill the seeds on the ground.* Time has shown that where plantations are kept in good order, and supplied with cats and fox terriers, and poison used occasionally, the rat plague seems to have been all but eliminated, and the cacao industry is in a very healthy state.

Last year's production only amounted to 116 tons, but as many new acres are now in bearing it is expected that during 1908 fully 250 tons will be exported, while in 1909 and 1910 very large sections will come into full bearing, so that the output, it is hoped, will run up to within the neighbourhood of 1,000 tons.

* In Jamaica, our old friend Mr. Cradwick has discovered, whilst spraying cocoa trees against fungoid troubles with Bordeaux mixture, that rats would not go on these trees. How long the effect of such a spraying—which, if it thus serves several purposes, would be invaluable—will serve against rats has still to be found.

The planting of cacao continues unabated, and many rubber planters are setting out cacao trees between the rows of rubber, hoping to get a double crop in this way.

Good cacao lands are obtainable at prices ranging from $3 to $50 or more per acre, the price being chiefly regulated by the position of the area offered for sale. Generally the quality of the land is pretty well the same.

Chinese coolies brought into Samoa and working under governmental supervision perform most of the work. They cost the planter on an average about $10 per month, which includes cost of introduction, keep, medicines, hospital, and return after three years. As a good many Chinese elect to remain in Samoa after their term of service is over, it is evident they are well satisfied with existing conditions.

School facilities are fair for the lower grades, no attempt as yet being made to pass students beyond the common grammar school education. Taxes are moderate, and the general treatment of foreigners by the official classes is unexceptional.

THE INDIAN TEA INDUSTRY.

OPENING OUT A TEA GARDEN.

(From the *Indian Agriculturist*, Vol. XXXIII., No. 12, December 1, 1908).

Comparatively few new gardens are being opened out now, but here and there one is occasionally met with,—out gardens are being added on to existing centres, and there are few old gardens which have not their annual few acres in the shape of odd corners, etc. The man who undertakes to open out a new Tea Garden is incurring a much greater responsibility than he is usually aware of. Of course, there are men who have had a great deal of experience in opening out, and to such this article may be of little, if any, use, as they will most likely know all about it. But as fewer gardens are being opened out now than formerly, there are correspondingly fewer men experienced in the work. We may leave out the jungle cutting and clearing, as the best methods of going about this work will depend greatly upon the kind of jungle and the kind of labour. No two gardens will be exactly alike in these respects, and arrangements must be made to suit circumstances. So we may leave cutting, burning and clearing by simply remarking that cheeseparing at the

expense of thoroughness is the reverse of being economical. The choice of land may be left out as well, as, in ninety-nine cases in a hundred, the man who opens out will have no choice in the matter. With altered ideas as to planting generally, we now plant closer than we usually did twenty or thirty years ago, and 4′ × 4′ diagonal planting is more the rule than anything wider. The planter of a new garden ought to bear in mind that he is planting for posterity; not so much on his own account, as on account of at least three generations coming after him.

It costs no more to the planter to have his work pleasing to the eye by having his lines running straight in every direction as it will having them running anyhow and all ways. The roads ought to be systematically laid out according to a preconceived plan so that the mains converge on whatever centre has been determined upon. Some land is naturally adapted for being accurately laid out so as to have all or nearly all the sections of the same size, but it is always possible to make the best of the worst lay of land, and unfortunately it is not always done.

PITTING AND PLANTING.

Having got our land staked out, we now come to the most important of all opening out operations: pitting and planting. In trying to account for degenerated tea gardens, at a time when they ought to be flourishing in the heyday of youth, our experts have never given much thought to how they may have been originally planted. There are many gardens—a great many more than are suspected—which owe their falling off in the strength and vigour of the bushes to careless pitting and planting at their very inception. Even at the present day with all our progressiveness, there are more gardens being permanently handicapped through bad planting than there are otherwise. A pit for planting in should be nothing under two feet deep and ought to be filled to the brim with the surface soil of its own 16″ area space. The surface soil will be safer there and where the young plant can have the full benefit of it.

When the young plant is brought from the nursery the greatest care should be exercised never to expose any part of the young tender tap root to the sun. If possible the plant should be lifted with a ball of earth adhering to the roots sufficiently large to entirely enclose the tap root to its utmost tender tip. The young plant should be carefully planted in the centre of the hole, and if the point of the tap root is projecting beyond the ball of earth, the greatest care should be taken that it is planted *straight down*. If a plant has its tap root twisted to the side when it is planted it will never go down but will grow as it is, remaining at right angles to the perpendicular. Simple and all as this slight-looking mishap to the young plant's tap root would appear to be, it is a permanent injury from which there is no recovery. It never appears to be able to right itself and never makes a fresh tap root. The plant remains a surface rooter and annually suffers from drought every cold weather which causes it to "coppice." It has every appearance of being a bush growing upon a poor soil and responds to top dressing and manuring, but it is unable to hunt for itself for either moisture or food. The tea plant is essentially deep rooted and everything possible ought to be done to encourage this from the very start. It has never been determined how deep the tea root will penetrate. It is quite commonly found as much as 7′ and 8′ deep at the sides of road cuttings. It might almost be asserted that a tea root will go as deep after food as you can possibly make a drain deep enough to carry away the water and allowing the fertilising constituents of the air to penetrate. In certain districts a fairly severe dry spell was experienced during the last spring. A planter was showing another planting friend over his new extensions and asking his opinion of them, as they appeared to be hanging in the wind and making little progress and a very great many of them had died outright during the dry spell. The visitor who had seen the same before, promptly put it down to bad planting, and to prove it pulled up a few dead bushes and showed the twisted tap root and all other roots within 6″ or 7″ of the surface where they simply had had the life roasted out of them. The plantation was three years of age and had never been pruned as the plants had always been growing weakly. It is lamentable but true that gardens are still planted very badly. The pits are made far too shallow. The young plants are carried from the nursery piled on top of each other with broken and exposed roots. They are then dumped down into the shallow pits with hard impenetrable bottoms, the soil which was taken from the pit is hastily dragged in again, a few tramps of the feet and there you are; the woman has a swinging number for a *nerrick* to get through and, as she would ask you herself, "Kia kurega"?

NECESSITY OF FIRST-CLASS SUPERVISION.

When starting a squad of coolies on to plant, only a small number ought to be put on the first day, gradually increasing them as they thoroughly get their hands into doing the work well. In this work there can be no question of leaving it to the superintendence of a native. No matter how trustworthy a Babu may be, or how long and faithfully a Sirdar may have served your interests, the work must have constant European superintendence, and first class European superintendence at that. . . . A man in charge of a garden may make bad blunders in plucking, pruning, cultivation, or any other work, but the damage done can be remedied in more or less time, according to the nature and length of time of mismanagement. But one season's bad work when planting out can never be made good.

HOW TO PLANT THE TAP ROOT.

Returning for a space to the tap root. Every effort ought to be made to plant it straight down and it always ought to be borne in mind that it is better to *cut* a tap root than to plant it bent in a horizontal position. When the tap root is cut, the stump will send away two or three main roots more or less inclining downwards and sidewise, and, if the planting pit has been made big enough and filled with loose surface soil, these roots will incline further downwards and reach a fair depth and no material harm may ensue; always bearing in mind that, in the light teelah soils of Sylhet, the deep penetrating tap root is much preferable. But if the pit is made shallow these secondary roots, having the spreading inclination to start with, will take the way of least resistance and establish a spreading habit in the looser surface soil and most likely be cut short at the first deep hoe. Such a plant is forced to become a surface rooter, suffering every cold weather from drought. It has little power of reaping the advantages of deep draining, and before it has lived one quarter of its lifetime it has become an eyesore and is called a worn-out, deteriorated tea bush, occupying the ground but giving a small amount of leaf, and that of the very poorest quality.

COMPOSITION OF INDIAN RICE.

(From the *Indian Trade Journal*, Vol. XV., No. 186, October 21, 1909.)

A useful enquiry recently carried out by Mr. Hooper, of the Indian Museum, relates to the composition of Indian rice, which, as the staple food of the people, is one of the most important and extensively grown crops in this country, the area allotted to it exceeding seventy million acres. The subject is not exactly a new one, but Mr. Hooper appears to have collected all the available data in order to present a complete case. From these it appears that Mr. Balland as long ago as 1895 made an enquiry into the composition of the different kinds of rice imported into France. He found that decorticated rices from the principal localities, Carolina, India, Java, Japan, Piedmont and Saigon, showed a percentage composition varying between the extremes quoted below:—

	Water.	Proteids.	Fat.	Amyloids.	Fibre.	Ash.
Maximum	16·00	8·82	·75	81·35	·42	·58
Minimum	10·20	5·50	·15	75·60	·18	·42

So far as crude rices are concerned, he ascertained that they contain a higher proportion of nitrogenous and fatty substances and ash, the limits being as follows:—

	Water.	Proteids.	Fat.	Amyloids.	Fibre.	Ash.
Maximum	13·30	9·05	2·50	75·60	2·38	2·20
Minimum	11·20	6·18	1·85	73·85	·93	1·20

He also found that there was no connection between the size of the grain and the proportion of nitrogenous matter; and he demonstrated from his analyses that rice has more value as a food than is commonly supposed. The Cochin-China rice, for instance, although the grains are small, contain as much nitrogenous matter and phosphatic ash as some wheats and rather more fat.

In this connection the following analyses may be found of interest:—

	Water.	Proteids.	Fat.	Amyloids.	Fibre.	Ash.
Carolina...	13·10	7·10	·30	75·60	·19	·40
	15·20	8·82	·45	78·52	·28	·60
India ...	11·70	6·14	·15	78·60	·21	·34
	14·00	7·01	·45	80·27	·31	·44
Japan ...	12·30	5·50	·25	77 64	·21	·21
	15·30	6·98	·50	80·49	·36	·46
Java ...	12·20	6·67	·35	77·30	·24	·48
	14·80	6·86	·55	79·56	·34	·58
Piedmont	13·0	7·21	·35	75·77	·20	·40
	16·0	7·70	·45	78·21	·23	·44
Saigon ...	10·2	6·98	·30	76·96	·20	·28
	15·0	8·38	·70	81·35	·42	·56

Balland concluded his paper by praising rice as an article of food. He insisted that it has been used from time immemorial as a basis of nourishment in the East; that it transports easily, and keeps well as shown by analyses after twelve years, and is, therefore, an advantageous food material in times of peace and war.

With regard to the composition of purely Indian rices, Professor A. H. Church, in his *Food Grains of India,* states that analyses had been made of a large number of samples of cleaned rice, and these gave figures which were wonderfully accordant, considering the great differences in the appearance of the specimens and the very diverse conditions under which they were grown. He found that the nitrogenous constituents or albuminoids oscillate within narrow limits—probably nine samples out of ten, he thought, would be found to contain not less than seven per cent. and not more then eight. The composition of Indian rice is given as under :—

Water	12·8
Albuminoids	7·3
Fat	·6
Starch	78·3
Fibre	·4
Ash	·6

Dr. J. W. Leather gives the averages of four sorts of fine rice and four sorts of coarse rice as follows :—

	Water.	Albuminoids.	Fat.	Carbohydrates.	Fibre.	Ash.
Fine	12·25	6·45	·92	78·83	·21	1·33
Coarse	12·10	6·91	1·03	77·99	·45	1·57

In these analyses the albuminoids are said to be somewhat low owing to the "albuminoid nitrogen," equivalent to 90 per cent. of the total nitrogen, being calculated into albuminoids, using the factor 6·25.

Mr. Hooper reminds us that the proteins or albuminoids of rice have recently been studied by O. Rosenheim and S. Kajuira. These chemists find 7 per cent. of total protein present in rice, of which 0·14 is a globulin, 0·04 an albumin, and the remainder a protein which, like the glutenin of wheat, is soluble in dilute alkali.

It was pointed out in the *Indian Trade Journal* long ago that the polishing of rice meant a diminution in its nutritive value. Experiments conducted in the United States in 1904 proved conclusively that while raw rice afforded 9·88 per cent. of proteids, the brans or rice meals gave from 9·26 to 13·41 per cent. of proteids and from 9 to 14·3 per cent. of fat. The rice dust contained from 8·5 to 11 per cent. of proteids and from 5·2 to 6·9 per cent. of fat, while the polished rice, ready for sale, contained only 6·56 per cent. of proteids. The idea of polishing rice is, of course, simply to please the eye, and the practice is largely followed in most European markets and is likely to continue as long as the demand persists. Rice sustains a further reduction of its food value by boiling, which process removes more than half the fat, over 8 per cent. of the albuminoids, less than 8 per cent. of the carbohydrates, and 17·6 per cent. of the ash. There would seem, therefore, to be good ground for the idea that is fairly current in the East that parched rice contains the most nutriment.

The results of the analyses of one hundred and fifty-nine samples of Indian rice are tabulated below for easy reference :—

	Samples.	Water.	Protein.	Fat.	Carbohydrates.	Fibre.	Ash.
Bengal...	...14	11·10	7·51	·40	79·82	·44	·73
Bengal...	...12	12·37	7·09	·40	78·86	·48	·80
Eastern Bengal & Assam	16	11·19	7·67	·53	79·21	·58	·82
Burma...	...10	11·54	7·54	·98	78·59	·58	·77
Cuttack	...11	10·92	6·58	·31	80·81	·35	1·03
Central Provinces.	 7	9·05	6·68	·88	82·05	·42	·92
United Provinces.	...10	10·03	7·44	2·83	77·14	1·00	1·56
Nepal ...	...13	11·28	7·50	·85	79·13	·82	·92
Punjab	...14	12·89	6·98	·36	78·63	·89	·75
Bombay	...16	12·61	7·69	2·65	74·63	·89	1·53
Bombay	...14	13·15	7 27	2·56	74·90	·74	1·38
Madras	...11	8·94	7·10	·74	81·54	·43	1·25
Madras...	...11	11·69	6·81	1·03	79·00	·49	·98

Mr. Hooper explains that the average percentage of protein in these rices is 7·25, with the highest in Eastern Bengal and Assam and Bombay and the lowest in Cuttack and the Central Provinces. But the most interesting conclusions, he says, are drawn from the individual analyses where the percentage varies from 9·81 in a sample from Broach to 5·44 in a sample from Cuttack. It has been found that in some cases the local reputation and market value of rice coincides with its high nitrogen content. This is noticed in the case of certain rices of Eastern Bengal and Assam, Cuttack, Nepal, and Bombay. In other cases there is no connection between the high market value and the nitrogen contents, as instanced in the *dadkhani* rice of Bengal. The examination has resulted in giving a prominent place to certain rices which deserve attention at the hands of cultivators as containing over 8 per cent. of albuminoids.

Finally, it has been demonstrated that the richness of the grain appears to be due not so much to the races of the plant or the appearance of the grain as to the cultivation. The secret of an abundant crop of excellent rice lies in

the liberal use of suitable fertilisers, but this aspect of the question never seems to strike many cultivators, while others are probably too poor to give effect to it. It is a matter that should right itself in time as the demand for still better rice increases.

THE QUESTION OF A BANANA INDUSTRY.

By F. A. Stockdale.

(From the *Journal of the Board of Agriculture of British Guiana*, Vol. III., No. 2, October, 1909.)

During the past three months, the question of the possibility of establishing a banana industry in this colony has been engaging attention in many quarters. Correspondence has been carried on through the medium of the local press, and several public meetings have been held in different villages, particularly along the East Coast.

This is not the first time such a question has been raised. In 1888, the possibilities of establishing a banana industry were considered, and in May of that year a resolution was agreed to in the Combined Court recommending a subsidy to the Bay State Fruit Company, to be paid over a period of five years, to establish a line of ships for the transport of bananas from this colony to American markets. Nothing, however, came of this suggested enterprise, and in March, 1889, a petition was passed in favour of another American company. A commission was appointed to carefully consider the matter, and it was recommended in a preliminary report that there should be placed upon the Estimates for 1889-90, $10,000 to defray the preliminary expense of encouraging the cultivation of bananas suitable for export, and that as soon as the Government should be satisfied that the Fruit and Banana Industry could be encouraged a subsidy for five years of $25,000 should be granted for transportation.

A sum of $10,000 was accordingly placed upon the estimates but was not expended, as those in the United States of America supposed to be interested in the movement took no further steps to start the industry on business-like lines, other than by supplying to the colony 10,000 suckers of the Jamaican variety of banana. Part of these were planted in the Experimental Fields at the Botanic Gardens, and an area of somewhat over two acres was kept under cultivation with them for three or four years. By order of the late Quintin Hogg several acres were planted with the suckers on the fields of La Penitence, to the south of the Experimental Fields, on which they grew in a sickly manner for a few years and eventually died out.

In the final Report of the Commission in 1895, it was stated—

(1) That at that time there were no regular cultivations of bananas, and there were but few bananas grown on plantain farms in an irregular way;

(2) That an average price of less than 25 cents per bunch would not pay the growers, and

(3) That no supply of bananas for an export trade then existed.

The Commission further expressed the belief that the fruit could be profitably cultivated to meet an export trade of 10,000 bunches a fortnight if suitable arrangements could be made.

In 1902, Professor Spawn came to the colony in connection with banana and coffee. Great interest was created in his suggestions, but nothing came of them.

In 1907, the Government made an effort to ascertain whether an export trade in bananas could be established on the lines of the arrangement made between the Government of Dutch Guiana and the United Fruit Company. All the attorneys and managers of sugar plantations and village councils were circularized, but of the forty-six replies received only seven were favourable, and therefore it was not considered possible to make suitable arrangements without an assurance that a large enough area would be cultivated to guarantee a sufficient number of bunches of bananas being produced for export.

The present movement has originated with the people, who being advised of the advances that are being made in Surinam with the banana industry, and of the fact that the line of steamers also calls at this colony, are of the opinion that arrangements could possibly be made with this line, or some other, to take bananas from this colony if they were produced in sufficient quantity. It is, therefore, thought that it might be of advantage to give a brief review of the present business in bananas, to indicate what points would have to be specially considered in connection with the establishment of a banana industry in this colony, and to give hints in regard to cultural and other matters that would be of value to the growers.

The World's Trade in Bananas.

I have not complete figures available for the whole of the banana-producing countries, but a consideration of those

that are here enumerated will indicate, in brief, the extent of the world's trade in bananas :—

Jamaica.—During the past three years, an average of 16,500,000 bunches have been exported, distributed as follows :—15,000,000 bunches to the United States, and 1,500,000 bunches to England.

Costa Rica.—In 1908, some 10,000,000 bunches were exported, but it was estimated that fully 2,000,000 bunches were lost through winds and storms. Some 7,000,000 bunches were exported to the United States, and 3,000,000 bunches to European markets, in which a decided effort is being made to introduce Costa Rica bananas.

Honduras.—In 1908, 4,300,000 bunches were exported as compared with over 5,000,000 bunches in 1906 and 1907. Further exploitation is being pushed forward.

Columbia.—Some 2,250,000 bunches were exported in 1908, and it is estimated that within five years not less than 5,000,000 bunches will be exported annually. There has been remarkable progress of late in this country. The first shipment of bananas was made in 1891, and for the first 13 years the exports never reached 500,000 bunches in any one year. In 1904, 780,000 bunches were shipped, and since then the exports have rapidly increased.

Nicaragua.—In 1908, 1,250,000 bunches were exported. Large areas have recently been granted for the growing of bananas and the exports should rapidly increase.

Other Countries.—Guatemala, 700,000 bunches in 1908, San Domingo, 450,000 bunches; Cuba, about 500,000 bunches; British Honduras, 400,000 bunches; and smaller quantities from Panama and Surinam, while the export from the Canary Islands of the dwarf banana was nearly 2,500,000 crates holding roughly 3,000,000 bunches of bananas.

The total trade to America in 1908 was about 32,250,000 bunches, and the trade to English and European markets was about 4,000,000 bunches of the Gros Michel or Jamaican variety and 3,000,000 bunches of the dwarf or Chinese kind.

POINTS TO BE CONSIDERED.

The first question to be asked is whether the soil is suitable and what area would be available within easy reach of the port of shipment. There are many circumstances that affect this issue. The cultivation of bananas is now carried on in a large number of countries, the prices are gradually falling, and only the best quality of fruit is now readily acceptable on the markets. In Surinam, 36 hours is given to cut and deliver fruit, and therefore it is essential for an export trade that the land on which bananas are cultivated be within near distance of the port of shipment. For an export trade of say 20,000 bunches of bananas a week, it would be necessary to have at least 5,000 acres under cultivation. In fact, the United Fruit Company in their Surinam contract stipulated that over 7,000 acres should be planted within three years of signing the contract, to ensure a minimum quantity of 20,000 bunches per week. Poor land or worn-out cane land will not produce first-class fruit, and therefore it is necessary at the beginning that the land should be of good quality. A large amount of our coast-lands would not be suitable for the successful cultivation of bananas, but it is probable, if means of transport to the seaboard were readily available, that much of the back lands would suit admirably. A good deal of the land on the lower parts of the rivers should also grow good crops of bananas, but cultivation could not be practised too far away from the port of shipment or otherwise the fruit could not be cut and delivered in the specified time.

The next question to be given careful consideration is the available labour supply. In Surinam, it has been found that it is necessary to have three labourers for every five acres of banana cultivation, but there are times when a larger number are required. It would most probably be found, that 5,000 acres under bananas would afford sufficient continuous employment for 3,000 people.

Co-operation is essential for a successful banana industry. It would be necessary that all the bananas be delivered at the port of shipment within the twelve hours immediately before the ships are scheduled to sail, and the previous twenty-four hours would be given for cutting, packing, and transporting to the port. A very efficient organization is required to accomplish all this work within such a limited space of time, and unless everything works smoothly, a considerable loss of fruit will result. In fact, the banana industry is now run on such modern business methods that it would be necessary for a considerable area of bananas to be planted in the same district under a single Association, in order that management expenses may be reduced, and in order that transport and shipment could be economically carried out. It is no longer possible for the small man to cultivate a few acres and to market

his fruit, unless it is through some central association, and furthermore steamship companies cannot be induced to put on a line of steamers unless a sufficiently large number of bunches is guaranteed, and sufficiently good security is forthcoming. The banana industry of Jamaica is now chiefly in the hands of large growers, while the cultivations in Central America are under the control of large companies that have many thousands of acres under single managements.

In Surinam, the nucleus of the industry is held by the Government itself. There are now about 5,000 acres under banana cultivation in that country, and practically none are cultivated by 'small growers.' The greater part of these bananas are at present grown upon lands that were abandoned from sugar-cane cultivation some 50 or 60 years ago, and upon lands that have in recent years been abandoned from cacao cultivation by reason of the witch-broom disease.

Finally, means for transport must be obtained. It depends of course as to what market it is intended to ship to and as to what variety would be the most suitable to grow. The American market will only take the Gros Michel or Jamaican banana, while the English market favours the dwarf or Chinese variety.

The Jamaica and Surinam trade, as also the greater part of the Central American, is in the hands of the United Fruit Company. They may be said to control the whole of the market in Gros Michel or Jamaican bananas. It must, therefore, be assumed that this company would have to be approached if a successful trade were hoped to be built up with America.

The United Fruit Company has a most efficient organization in all the banana-producing countries with which it is connected, and is, at present, rather inclined to favour extension of operations in the fields in which it is thoroughly established than to look for new fields to work up, unless exceptionally favourable terms are offered. Any business man, on carefully examining the Surinam contract must note that the Company requires particularly favourable conditions. The whole of the organization was left to the Surinam Government, who had to guarantee that a certain area would be planted within a certain period, and that the shipments would reach a certain size. It is more than probable that similar conditions would be required in the case of any similar contract for bananas from this Colony, and it would therefore be necessary for a considerable area to be guaranteed to be planted in bananas before such a contract could be entered upon. For the American market it would seem that only the United Fruit Company could be approached, as other companies could not compete with such a monopoly as the United Fruit Company holds.

Could bananas be shipped satisfactorily to England? They are being shipped in large quantities from Jamaica and Costa Rica, but the dwarf or Chinese variety from the Canaries still commands universal favour. An examination of the few details of the Barbados experiment would indicate that the Chinese variety of bananas can be shipped satisfactorily in cold storage, if packed in cotton wool in crates. A direct steamship service capable of accomplishing the journey in 10 or 12 days, would be necessary, and the rates of freight would have to be sufficiently low to afford a reasonable margin of profit to the growers. The rates of freight from the Canaries during 1907 ranged from 1*s.* to 1*s.* 3*d.* per crate, but this was considered high and caused a certain amount of dissatisfaction among the growers.

In conclusion, the methods of cultivation in vogue in this colony would be entirely unsuited for the successful cultivation of bananas for an export trade, and a careful consideration of the Jamaica methods, a brief account of which is appended herewith, and of the leaflet lately issued by the Board of Agriculture is strongly recommended. The opinion formed by the Department of Science and Agriculture is that, supposing a sufficiently large area were put in banana cultivation under the control of a strong organization to form a nucleus for the industry, the smaller growers could, with careful attention to cultivation, etc., be encouraged to plant bananas and would make a fair profit. Without such a nucleus, however, the smaller growers could not themselves establish a successful industry.

THE BARBADOS EXPERIMENT.

In May, 1902, the Superintendent of the Royal Mail Steam Packet Company at Barbados, invited the Imperial Commissioner of Agriculture to test a new banana carrier by which it was proposed to carry bananas from the West Indies to England. It was found that the dwarf or Chinese bananas could satisfactorily be carried in the ordinary hold

during the cold season, but that in the hot season the shipments arrived in an over-ripe condition. Hall's system of cold storage was therefore installed in some of the ships of this line, and larger shipments of bananas were made. In 1902, 18 bunches of bananas were shipped; in 1903, 6,691 bunches; in 1904, 15,326 bunches; in 1905, 28,008 bunches were shipped up to October 5th. In July of 1905, however, shipments of bananas from Trinidad occupied a considerable portion of the cold storage holds, and the Barbados bananas had to be put in other parts of the vessel, with the result that the 10,439 bunches shipped from October 5th, 1905 to March 31st, 1906 netted in England only about 2d. per bunch. This meant a loss to the planters of nearly one shilling per bunch in freight and other expenses alone, and consequently growers discontinued to ship.

The Barbados bananas when they arrived in England in good condition commanded a ready sale and netted to the planters from 2s. 3d. to 2s. 6d. per bunch, and as the cost of crates, packing, etc., amounted to about 1s. 3d. per bunch, the net profits on good shipments worked out at about one shilling to 1s. 3d. per bunch. Without assured space in cold-storage holds it was found impossible to ship the dwarf or Chinese variety successfully.

JAMAICA METHODS OF CULTIVATION.

The method of cultivating bananas in Jamaica differs considerably from that practised in this colony, and it is thought that a brief description of the former practice may not be without interest:—

If forest land is brought under banana cultivation some planters simply cut and burn, leaving the stumps to decay. Others, however, prefer to stump the land as soon as possible, in order that the suckers may be put in regularly and so that ploughing may be carried out much earlier than if the stumps were not removed. Virgin land is not ploughed, however, for the first crop. Old cane land or pasture is thoroughly ploughed to at least nine inches deep. This ploughing is generally done in January. The land is then carefully harrowed. It is allowed to lie fallow until the beginning of March, when it is cross ploughed and harrowed. The fields are then lined ready for planting, which is usually done in the end of March or the beginning of April. Hill lands cannot be ploughed. They are, therefore, forked before being lined for planting.

Great care is taken with the drainage and irrigation systems, as it is absolutely essential for a successful banana cultivation to have good drainage, and the irrigation system must be laid out so that the smaller water channels may be easily changed as occasion arises.

PLANTING.

Planting is generally done in Jamaica from January to April in order to catch the high prices of the American market. Where irrigation is not possible March and April are recognised as the planting months, so that the suckers may be ready to benefit by the rains that commence in May.

The usual distance for planting on the south side of the island is 14 feet × 14 feet, while 15 feet × 15 feet is generally recognised as being most suitable on the southern side. The distance in the hills is usually 12 feet × 12 feet. Experiments have been tried with planting 15 feet × 10 feet or 15 feet × 8 feet, with varied results, while 8 feet × 8 feet and 10 feet × 10 feet are not uncommon in some of the very hot flat lands, in order to shade the ground as soon as possible after planting. The general concensus of opinion throughout the island favours the wider planting, as the bunches are of better size and quality. The holes are usually dug from 2 feet to 3 feet square and vary in depth from 1 foot to 2½ feet. The deeper holes are generally advocated where labour is plentiful.

SEED-SUCKERS.

The suckers which would be selected for planting are not the same as those that would be chosen in this colony, and the method of treatment is totally different. Suckers for planting purposes are suckers that have not been cut back, or in other words "sword-suckers," —as indicated by their first leaves being very narrow—which have been allowed to grow to about eight or ten feet in height and which have large bulbs at their base. No small suckers, such as we choose in this colony, are taken. In preparing their suckers for planting, the Jamaicans cut down those selected to within about six inches of the ground and then dig out the bulbs. All the old roots are then trimmed off and the bulb is planted so that the eyes are at least three or four inches below the level of the ground. From this bulb, three or four suckers will spring up. The strongest one is selected, and all the others are pruned off until June when one or to suckers are left, and then again all others are pruned off until October when there is again left either one or two, and finally another

is left the following February. It is calculated that the first suckers should fruit in the following March, the June suckers in May, the October ones in February or March twelve months, and the February one in May or June twelve months. This system for timing is the outcome of long experience and could not be adopted in this colony without modification, on account of differences in climatic and rainfall conditions.

IRRIGATION AND AFTER-CULTIVATION.

When the suckers are first planted the smaller water-channels are put close to the suckers, so that they may get the benefit of all the water, but after they have become well established it is the usual practice to run the water channels in the centre of the rows, for the bananas benefit more thereby, and the stools do not produce such a large number of suckers as if the water were actually around the stools.

When the suckers have become established, shallow ploughing is generally carried on until November once every eight or ten weeks, one ploughing with the rows and the next across the rows. Each ploughiug is followed by a light harrowing to break down the soil and to keep the land clear of weeds. After November, ploughing is generally stopped until after the main crop for the American market has been picked. During this period, as also during such rainy weather that the plough cannot be used, the weeds are kept down with a cutlass or hoe.

In those parts of the island where ploughing is not generally practised, or on those lands where ploughing is impossible, constant forkings are given during the earlier growth of the suckers, while during the fruiting period all weeds are kept down with the cutlass. Very particular attention is given to cultivation in order that the maximum quantity of large bunches may be obtained. It is useless to expect good results unless good tillage is given frequently; for it has been found that bananas cannot be made to yield satisfactory profits if cultivation is carried out "on the cheap."

In some districts, artificial manures are applied to bananas, but the most satisfactory results have been obtained from pen manure and other humus-forming substances. All the old banana stems, trash, etc., are cut up and ploughed in with beneficial results. Their application improves the general texture of the soil and makes it drain more readily.

REMOVAL OF LEAVES AND SUCKERS.

As the leaves decay, they hang down around the stem. It is the usual practice to allow a few of these to remain as they protect the stem from the sun, but if they become numerous some of them are removed, or otherwise they tend to cause the stem to shoot up rapidly and to become weak and slender, incapable of bearing a full bunch of fruits. In no case are hanging leaves allowed to trail upon the ground. Such leaves are pruned away.

All suckers that are not intended to yield fruit are carefully removed. They are usually pruned away from their parent bulbs when they are quite young, for if they are allowed to grow large they drain food-materials from the main stems, and small bunches result. In all cases every effort is made to cut the suckers away from the parent bulbs or otherwise they rapidly spring again.

PICKING THE FRUIT.

The picking of the fruit is done by the hundred stems. Each plant is partly cut through some five or six feet from the ground, so that the top of the plant, with the bunch, slowly falls over. The bunch is caught so that it does not get bruised and is then severed and handed to women, who carry it to a certain place in the plantation. Here a book-keeper enters it up as being a bunch ot a certain size, or discards it as being unsuited for export.

The bunches are then wrapped in trash, and handed into a cart, where they are carefully packed for transport either to the sea-board for shipment to Kingston in punts or to one of the numerous sheds along the railway line for receipt by the banana trains that run to the wharf and unload direct into the steamships that carry fruit to either the American or the English markets.

In picking the bunches in the field it was formerly the usual custom for men to work singly, but now greater care is being taken on some of the estates. They work in pairs, the one to cut the bunch down and the other to catch it and hand it to the women who carry the bananas to be noted by the book-keepers.

CUTTING DOWN OLD STEMS.

After the bunch is cut off, the head of the plant is completely severed from the stem some distance above where it was partly cut through at the time of picking. The top part of the stem and the leaves that have been cut off are then chopped up and spread over the land ready to be

ploughed in, while the lower part of the stem is left standing to decay. It is generally held that a fair task for a man is to cut and chop about 100 stems per diem.

REPLANTING.

In a banana plantation some planting is done every year. It depends largely upon the nature of the soil, and upon the locality as to how long bananas may be ratooned. In some districts replanting is done every three years, while in others six years is not considered too long for ratooning. A field to be thrown out is planted in vigorous-growing leguminous climbers such as the velvet bean, etc. These plants climb over the banana plants and soon kill them out. They are then all cut down, cut into pieces, and ploughed in. After a time, the field is replanted, the new rows alternating, if possible, with the places where the old ones were. There is a growing tendency throughout the whole island to reduce the period of ratooning and to replant every two or three years, as it is found that by so doing the crops may be better timed for the American market, as after first ratoons the plants fruit somewhat irregularly.

YIELDS.

The general yield for the whole island is about 280 payable bunches per acre per year, but on well cultivated lands 325 to 330 bunches are considered by most planters as being a fair average. As a rule, it is held that about 65 per cent. of plants should yield bunches, and at least 85 per cent. of first ratoons.

Yields depend largely upon locality, soil, irrigation, cultivation, etc., and vary considerably throughout the island, but it is generally recognised that the best results can be obtained only by intensive cultivation.

COST OF CULTIVATION.

The cost of cultivation varies slightly in the different districts, but it has been found that the average cost of preparing the land, after-cultivation, interest and depreciation on capital, outlay for buildings, roads, etc., would amount in an irrigated district from £12 to £15 per acre during the first year, and an annual expenditure of from £10 to £12 afterwards. For non-irrigated lands the cost would be from £9 to £12 during the first year and £8 to £10 afterwards. These estimates assume that suckers are readily available and do not have to be bought.

JAMAICA PRICES.

The prices given by the United Fruit Company per 100 bunches to those who contracted to supply a certain number all the year round were in 1901, as follows:—

January £6, February £7 10s., March £10, April £12 10s., May £12 10s., June £11 10s., July £7 10s., August £5 10s., September £6, October £6 5s., November £6 5s., December £5 10s.

In 1906, the contract prices were:—

January £5, February £6 5s., March £10, April £12 10s., May £12 10s., June £11, July £8, August £6, September, October, November, December £5 per 100 bunches.

I have no figures later than 1906, but there has been a large increase in banana production in Central America, and the ruling prices are now somewhat less than they were in that year.

TALIPAT SUGAR.

(From the *Indian Agriculturist*, Vol. XXXV., No. 1, Calcutta, Saturday, January 1, 1910.)

The Talipat (*Corypha umbraculifera*, Linn.) is among the stateliest of the many stately palms of the Tropics. Stalwart, stupenduous, majestic, grand, —it is typical of the gorgeous glory of the East where feathery forms that love the light shoot up into golden skies. With a varying height of from 40 to 80, enhanced by an enormous spadix that reaches up to another 10, 15, or even 20 feet, its rough annularly-scarred stupendous stem attains to a girth of from 6 to 10 feet. Unlike its congener, the great Palmyra, it does not hug the sands of the coast; but, heading inland far beyond the limits of the spontaneous growth of that palm, it flourishes best on the clays and loams of the secluded valleys and plains of the interior. These soils it loves far better than sand, these situations more than the garish light or the salt sprayed wind of the bleak sea-coast.

Like the greyish-green Fish-tailed Palm, the Caryota, it is relatively scarce and almost as short-lived. Throughout the indigenous regions of their growth, both Talipat and Caryota are usually self-sown. The hard, horny-albumened seed of the Talipat germinates, however, with greater difficulty; and, being extremely delicate when young the seedling seldom survives transplanting. It has to be sown if it is to be grown. For these reasons, chiefly, it is that the palm is scarcely, if ever, regularly grown; so that the sporadic nature of its installation will, under present conditions, endure for years.

Single palms or, at best, clumps of a few, sown by the haphazard sprouting of seeds cast by the agency chiefly of birds, occur at intervals usually far: so that the local exploitation of the species for sugar is generally more tedious than that of the Caryota. Nevertheless, it is now regularly tapped in the plains of the sub-arid regions of Burma wherever it occurs in suitable numbers and is vigorous enough for a profitable yield. The practice of tapping the Talipat in Burma is invested with an element of peculiar interest particularly when it comes to be known that the palm, as a source of toddy or sugar, is unknown in the more favoured regions of its growth. In the cool fertile valleys of the lower Western Ghats, —in Canara, Malabar, Cochin, Travancore,—where the species may be said to be complete at home, crowning the already stupendous sylvan vegetation, its enormous panicle of myriads of flowers bursts through the tough integuments of the spathe to but "waste its sweetness in the desert air." In Burma, however, the Talipat is tapped for the saccharine sap which is drawn from the spadix. Varying with the factors of the locality in which it grows, the Talipat is said to reach exploitability between the thirtieth and fortieth year of its age. On the completion of the period of its vegetative growth, it sends up, at the top of the stem, a single spadix of enormous size. Unlike the development of the generality of other palm-spadices, that of the Talipat is remarkably slow. It is said to attain to a height of six feet and a basal girth of from two to three feet in not less than two months from the date of its emergence. At the end of this period and before the spathe bursts, the tapper ascends the gigantic stem by means of light ladders constructed of bamboo. Frequently these ladders consist of nothing more than single bamboos on which portions of the arms are retained to serve for rungs or steps. The bamboos are securely lashed to the stem, one beyond another, up to the top. At the top and over the bases of the leaf stalks, the tapper constructs a platform of bamboo work immediately around the base of the spadix. This done he straightway proceeds to cut away the whole of the spathe investing the spadix. The latter is now bound round, at intervals, with long strands of rattan or other stout fibre, from its base to a height reaching up to his head. The intervals between the ties vary much but are not usually greater than 6 or 8 inches. The ties are further tightened by ramming, like wedges, short lengths of round sticks between them and the spadix. Care is taken, however, to see that the skin of the smooth tender spadix is not broken or bruised. The top of the spadix is then cut with a *dah* (in the present case a very sharp, light, thin bladed knife) the cut-surface being shaped in the form of a V. This incision is practically the result of two-clean cuts which, proceeding from right and left of the upper periphery of the spadix converge and meet to form the lower edge of a more or less prismoid valley below. Thereafter, a small, shallow, semicircular notch is cut on the spadix about 6 inches below the edged base of the channel. Into this is inserted one end of a slip of palm leaf to serve as a conduit for the sap. The slip is tied to the spadix with string. The binding of the spadix with strong ties of rattan serves to increase the pressure inside it; and when, after the binding and wedging its top is cut off, the *toddy* or sap trickles into the pot. About three hours after this first operation, the tapper ascends to the platform again. The first pot will be full; so it is replaced by another and, frequently much larger one. At the same time, the cut-surface is carefully pared by successively removing thin slices from it. But for the parings the cut-surface gets clogged and the free flow of sap is impeded and hindered. The insides of the pots that are used in the tappings are previously freely exposed to the smoke of lighted palm leaves, straw and rubbish of sorts. This smoking is said to prevent fermentation in the sap and to clear it as it collects in the pot; otherwise it would be acid and turbid. Again, in the pots to hold *toddy* for *Jaggery*-making, handfuls of the powdered bark of the *Té* (*Diospyros burmanica*, Kurz; *Diospyros pyrrhocarpa*, Miq; or *Diospyros montana*, Roxb.; or of the Tanaung (*Acacia leucophlœa*) are sprinkled before they are slung on the spadix. In spite of these most interesting precautions, the *toddy* obtained in the first ten days or fortnight is scarcely drinkable owing to its rank raw vegetable flavour. But it soon becomes both sweet and palatable, when it may safely be drunk to any extent. Its internal exhibition is, in fact, seldom attended with inebriation thereby seemingly forming an exception to the familiar inexorable law of all *toddies*. By no means is it a drunkard's drink; but, for all the liquids, juices or sap one *can* drink in the plains on a burning hot day, commend me, kindly, to that of the Talipat. In sweetness it is, at the best of times, inferior to the *toddies* at present obtained from the rest of the Indian Palms that are tapped; but, as might be expected,

regarding yield, it is superior to even the great Caryota; for the average capacity of the pots that are used for drawing the *toddy* from the Talipat palm is usually about 20 quarts: and, when it is remembered that the flow of the sap is so rapid and copious as to necessiate the renewal (changing) of the pots at least six times in the 24 hours, *i.e.*, thrice in the day and three times at night, it will be conceded that the palm compensates the incessant labour called forth in its tapping. To this must be added the remarkable fact that after the whole of the spadix has been sliced away in the incessant tapping during a period of four months (November to February), the operation is in most cases continued into the tapping of the delicate "cabbage" and is frequently cut through in three months; so that a total period of seven months elapses before the tapping gives over completely. The yield, however, is not constant throughout even the first period of the greatest flow. The tapping of most of the palms begins early in November, and the highest yield is attended in January; thereafter, it slowly but steadily declines until the middle of the "cabbage" is reached, when it gives clear symptoms of distinct diminution. Calculating the yield at the average rate of 20 gallons per day (24 hours) for a period of five months, the enormous figure of 20 by 5 by 30 or 3,000 gallons is indicated. The major portion of the *toddy* of the Talipat is used in the manufacture of *jaggery* or *gur*. For this purpose three pots, each of them nearly full of the *toddy*, are placed on long ovens near the foot of the tree. The fires are then lighted and the *toddy* is boiled until it turns syrupy and thick. The contents of two of the pots are now poured into the other, and in it they are boiled for a few minutes longer. The pot is then removed from the fire and, on cooling, the *jaggery* is rolled by hand and made into balls. It takes an hour to boil the sap. The yield of *jaggery* varies much; but, on an average, one pot (20 quarts) of *toddy* boils into one viss ($3\frac{1}{2}$ lbs.) of *jaggery*. The *jaggery* is sweet and resembles that of the Palmyrah, but it is frequently somewhat darker in colour. It sells locally at from 3 to 4 annas per viss.

TIMBERS.

WOOD FINISHING.

BY WILLIS T. POPE.

(From the *Hawaiian Forester and Agriculturist*, Vol. VI., No. 11, November, 1909.)

For some years I have been considerably interested in wood finishing, particularly that part which involves staining, filing and polishing. It is a great field of work, ever attractive and pleasing to investigate. New matter and different results are constantly presenting themselves. Though wood finishing is one of the very oldest arts, and one that requires much knowledge of materials, as a craft we find little literature regarding it.

Good instruction in iron work and wood work can be procured easily in almost any of our industrial and manual training schools, but, as a rule, very few lessons are given in the finishing processes that go to make an attractive piece of wood work, whether it be a piece of furniture or the interior of a dwelling. As a people, we depend almost entirely upon untrained workmen for our information. Good polishers very seldom know much about materials and their sources. They have little information to give away, and the secret of their success, when found out, is about the same old receipt made good by hard rubbing.

In discussing briefly the subject of wood finishing, I will no doubt dwell upon particulars of which you are more or less familiar, but I trust the interest will be worth the short while taken.

No two species of trees produce wood of exactly the same structure. There is a great variation in woods of the same species, in fact a distinct study in each separate piece.

Examine almost any piece of wood, and in a general way we find it composed of small cells of various kinds, usually long and tubular, running lengthwise, and adhering to each other more or less strongly. These cells have had special uses in the life of the tree, some were for conducting crude sap from the roots to the crown, others acting as storehouses for digested plant food, and still others have long acted merely for strengthening the tree and holding it together. Investigation shows that some of the cells have thick walls and small openings, others, thin walls and large openings. Most specimens of

wood have these different kinds of cells arranged or grouped together in such a way as to form the *annular rings* which are so distinct on the cross section of most lumber and give the beautiful watered grain to longitudinal sections.

When the growth of the tree begins in the spring or at the beginning of the wet season in most tropical countries, there is a great demand for water in the crown where the multitudes of new leaves and twigs are forming, hence a new layer of large loose thin-walled cells is rapidly built; when the demand for crude sap is not so great, and when there is plenty of digested food to supply building material, the cells formed are narrow and thick walled, thus the latter growth of each season is heavier, stronger and darker in colour than the earlier growth. As long as the tree is in good condition, distinct rings are left, one for each year, which the foresters and lumbermen make use of in determining the age of the trees of the forest. Fire or insects or anything of the kind damaging one side of the tree will often be the cause of incomplete annular rings. Seasons of drought leave narrow and indistinct rings that prove correct records of those dry years throughout the existence of the trees. These accurate records were very valuable to the parties who determined the great age of the grand Sequoias of California.

Other markings, pecular and interesting, and that have much to do with the finishing of some species of wood, are the dappels of thin plates of cells belonging to the *Meddulary rays.* These lines of cells run from the pith in the centre to the bark as longitudinal layers. Their function is to strengthen and bind the annual layers. Though they are present in most tree stems, they seldom appear more than faint lines radiating from the centre of cross sections. In oak they are very conspicuous and add great value to it. To get oak boards well marked with these medullary rays, the logs are cut into quarters, each quarter being ripped up into boards with their cutting plane oblique to the quartering cuts (or as near as possible along the lines of rays). This brings the surfaces of the boards nearer to the radiating medullary rays of the log, thus giving many of the dapples on each surface. This quarter cutting greatly increases the cost of the lumber because of the waste, but at the same time increases its strength and enhances its beauty. Trees of the forest that yield the most handsome lumber with a beautiful and well marked finish are those which have plenty of room for growth, which are exposed to winds that cause them to bend and toss, and which have ample light and space for development.

The composition of wood is of importance to the wood finisher. It is briefly but well explained in "A Primer of Forestry," Bulletin No. 24 of the Division of Forestry, U. S. Department of Agriculture.

"Wood is made up chiefly of carbon, oxygen and hydrogen. When perfectly dry, about half its weight is carbon and half oxygen and hydrogen, in almost the same proportion as in water. It contains also about one part in one hundred by weight of earthy constituents. The nitrogen and water taken up by the roots were originally in the air before they reached the ground, it is true, therefore, that when wood is burned, those parts of it which come from the air go back into it in the form of gas, while those which come from the soil remain behind in the form of ashes.'

The cell structure of most woods, as left by the smoothing tools of the workman, is so open that it is difficult to get a finished surface without using considerable expensive polish or varnish, which would have to be applied in thin coats with considerable time for each to become hard. This difficulty is overcome by the use of a *filler;* the name implies its object. A cheap, durable mixture is rubbed into the openings of the wood forming a body, or foundation upon which the finish is to be placed. Very hard, close grained woods, as olive, lignum vitæ and some species of eucalyptus do not need the filler.

Wood filler for many kinds of woods may be purchased ready for use. Cheap varnish is sometimes used as a filler, and shellac cut with alcohol makes one of the best for work where the pores are not too large. Large cracks may be filled with a composition consisting of rosin and beeswax. Two applications of filler, if well applied, are usually satisfactory for any kind of finish. (The second coat should not be put on until about 36 or 48 hours after the first.) Too much of a single coat is apt to shrink away into the wood. Equal parts of *Japan drier* and *boiled linseed oil*, thoroughly mixed, with a body of *corn starch* to form a thick putty-like paste, thinned down to the desired liquid with turpentine, makes a filler that is suitable for most woods. Instead of corn starch, some earthy material as plaster of paris, whiting or pumice stone

is sometimes used, but the oil reliable corn starch has proven satisfactory.

Just a few words as to those materials that form the filler. Japan or Japan drier is a brownish liquid having somewhat the nature of varnish, called a drier on account of its property in paints, etc., is made by cooking gum shellac with linseed oil; the mixture is cooked down to a very thick fluid and then thinned with turpentine. Shellac is the shell form of *lac*, a resinous gum produced on several kinds of trees by a species of scale insect in the East Indies.

Boiled linseed oil, as most of us know, is a product of the flax seed obtained by placing the crushed seeds under great pressure, and the extracted oil then boiled with litharge (sugar of lead) which leaves a liquid varying from light umber to dark yellow in colour, with the property of drying quickly when spread in a thin layer. The turpentine, of course, is the liquid obtained from the rosin of several species of pine trees.

Fillers are usually applied with a brush, sponge or piece of cloth. A few minutes after the application the work should be rubbed vigorously with another cloth, a piece of canvas, first crosswise and then lengthwise. It is not uncommon to add a little chrome yellow, yellow ochre, venetian red or burnt umber or some other colour to the filler, which often improves the appearance of the wood. In finishing carriages, pianos and small articles, it is not uncommon for the workman to use polish, rubbing into the fresh application finely powdered pumice-stone, just a little at a time. The object of this is two-fold, for leveling down and givinig an even undersurface and to work a durable mineral material into the pores

The *staining* of woods may be considered for several purposes.

First, to preserve the wood; second, to station common woods to imitate superior classes, as the staining of commn oak to give it the appearance of antique oak or as golden oak; third, staining to add uniformity or colour throughout a piece of work. Wood of the finest quality, no matter how carefully selected, will be given some staining medium when it passes through the French polisher's hands, which he claims is done to bring out the beauty of the grain.

Staining has become very popular for house furnishings of late years on account of its cheapness and the fact that it does not destroy the natural beauty of the wood. It is less expensive to keep woodwork fresh and clean, when stained, than it would be to apply successive coats of paint and varnish.

Stain may be applied as an opaque coating on roofs and the exterior walls of houses, and again it may be applied as a thin wash, giving colour to some depth, but leaving visible the character of the wood.

Some years ago, wood finishers used a great many vegetable dyes for colouring wood, and when a dry pigment was applied water was usually the vehicle used to carry it into the wood, but turpentine, alcohol or an oil has been found to be better, as it does not raise the grain of the wood. If the liquid used as a vehicle to carry the colour pigment into the work is a good wood preservative, the stain will have double value, *i.e.*, to give colour and preserve. Boiled oil is highly recommended as such a liquid. A very good stain is composed of two parts of turpentine, one part of boiled linseed oil and a little Japan drier, these added to the colour pigment that is selected, venetian red, burnt sienna, vandyke brown or crome green or some other colour. In such a stain the oil gums the pigment, the turpentine keeps it thin until deposited in the proper place and then evaporates, and the drier helps to set the mixture.

I am told that many stains sold ready for use contain carbolinium, kerosene and various other oils that act as wood preservatives; denatured alcohol is also much used of late. Most of these are cheap and reliable. One gallon of liquid stain will cover about a hundred square feet, and after buying a few small sample bottles and finding a suitable one, you can usually rely upon getting a further supply to match. It is a good plan, and often saves much disappointment, if, before staining, a few small pieces of wood are experimented with till the required result is obtained.

"Aniline" dyes may be usefully employed on wood for self-colours only—as distinct from various imitations of woods. Their introduction a few years ago, I am told, produced a disastrous effect on the old vegetable dye market, nevertheless many of the vegetable stains are exceedingly useful.

Logwood stain, made from boiling the chips of the logwood tree (*Haematoxylon*) is still a much used vegetable stain. This product is imported from Central America and the West Indies. We have a few specimens of these trees about Honolulu. It does well in most warm regions of the earth.

Other dye-woods worthy of mention are red sanders, orchella weed, safflower and nut-galls.

Many colouring materials are to be obtained from common plants. The well-known blueberry, when boiled down with a little alum and a solution of copperas [sulphate of copper], will develop an excellent blue colour; treated in the same manner with a solution of nut-galls, it produces a dark brown tint; with alum verdigris and sal-ammoniac, various shades of purple and red can be obtained from it. A good green stain is obtained from broom corn.

Stain is usually applied with a brush, sponge or cloth, and on surfaced work, where the grain of the wood is to show, the excess is wiped off with a cloth in a few minutes after the application.

After a piece of wood has been stained, it can be given one or more coats of white shellac, smoothed with fine sand-paper and varnished. Varnish is a viscid liquid, consisting of a solution of resinous matter in oil or a volatile liquid laid on work to give it a smooth hard surface with a gloss.

Manufacturers claim that varnish should be used just as it is sold. While it is true that it is a mistake to add anything to the finer grade of varnish, the poorer qualities are often too thick to work freely without diluting. If it is necessary, add turpentine until the varnish spreads freely with a brush. After varnishing, let it stand for at least 24 hours, by which time the coat will be hard. A coat of varnish over one that is not hard will often result in *sweating* which will necessitate scraping the work and recommencing the job from the beginning. A good many have shellac for the first coat to fill the pores.

To apply varnish properly requires a good deal of practice, and it is impossible to lay down rules that shall govern the process. The inexperienced almost invariably applies too much varnish and the result is it cracks. Where several coats are given, rub each down with fine sandpaper after it dries so as to give a smooth well filled surface for the next.

Spirit varnishes consist of alcohol and a vegetable gum as gum sandarach, gum copal, gum mastic, or a combination of mixed gums.

Alcohol and gum shellac also make a good spirit varnish. More quickly drying varnishes are said to be made of the gum cut with ether.

Linseed oil is the principal oil used in the manufacture of oil varnish. This varnish has a tendency to settle in a more even layer after spreading, although it takes longer to dry.

A wax polish proves quite satisfactory on many kinds of wood. The ingredients are beeswax and turpentine with more or less rosin added to harden the surface, but many do not add the rosin at all. A good way to prepare the wax is to melt the beeswax, and before it has time to cool, add the turpentine. Caution is necessary as both the wax and the turpentine are very volatile. As in the stain, the turpentine is merely the vehicle which enables the wax to be easily applied. In a thin condition, it may be laid on evenly over the work with a stiff brush or rag. After the wax has been spread the polish is obtained by friction, and the more it is rubbed, the brighter it will be. This final rubbing should be done with a hard, dry piece of canvas.

For most good work, French polish is to be preferred to all other finishes, as finer results can be obtained by it. It differs from varnish in that the resinous material is applied with a rubber (a hard pad of cloth) instead of with a brush. To become a good polisher, skill and practice are necessary as well as knowledge of material.

Polish requires that the pores of the wood be properly filled in order to get the smooth surface, fillers are used much the same as for varnish. After the fillers have thoroughly hardened, the laying on of the polish, which is called "bodying in" is begun. The way in which this is done greatly affects the appearance and durability of the gloss. When the body is too thin the gloss soon fades on account of the material sinking into the wood, and when the body is too thick it gives the finish the appearance of varnish.

The rubber is made of long strips of cloth rolled tightly and bound with a string or rubber band; this is put into a double thickness of cloth, linen preferable, the ends of which are gathered up and tied. This form of a rubber is not very useful for mouldings, but a similar wad can be made more pointed for the purpose. Old rubbers, if well taken care of, are better than new ones. They should be kept in an air-tight receptacle.

The process of applying the polish is somewhat as follows:—The wad is moistened with the polish and then covered with a cloth which is brought over the end smoothly, then rubbed briskly across the grain to let the

surface fill, after which the work is gone over with a series of circular movements, applying a moderate pressure, increasing a little as the rubber dries. In order that the rubber may pass smoothly over the work, a drop of raw linseed oil is occasionally added to the face of the rubber. As the rubber dries, more polish is added as in the first instance. A little polish will go a long way, and at no time should there be anything like a flow from the rubber. The first *bodying in* should be continued until the wood will absorb no more, after which the rubber mark will still show but gradually disappear in the finish. The final operation in French polishing by which the gloss is put on to the body previously applied is known as spiriting off and it removes all kinds of marks. This process partakes very much of the nature of bodying in. It consists in washing the bodied surface with alcohol. The surface is gradually reduced to a fine gloss with all blemishes removed.

To make a good polish, take about six ounces of shellac and add one pint of wood alcohol; great exactness in proportions is not necessary. Shellac dissolves gradually and the process is hastened by shaking, but heat is not necessary. White polish is made with bleached shellac, common polish with orange shellac. Manufacturers of polish assert that in addition to shellac, certain gums improve the quantity of the polish when properly used, but shellac is the principal ingredient in nearly all polishes. Gum benzoin and alcohol make a very good polish, but it is not generally used.

PLANT SANITATION.

NOTES ON CURRENT LITERATURE: ECONOMIC ENTOMOLOGY.

By E. ERNEST GREEN,
Government Entomologist.

BALLOU, H. A.—"The flower-Bud Maggot of Cotton, *Contarinia gossypii*, Felt.)." Reprinted from the 'West Indian Bulletin,' Vol. X., No. 1, pp. 1-28, 1909.

Describes the larva of a Cecidomyiid Fly (one of the 'Gall-Gnats') that has caused serious loss to the Cotton growers of Antigua. The insect breeds in the flower-buds of the cotton plant, causing them to fall off or so injuring them that they fail to develop. No suitable remedies have so far been discovered. Damp weather appears to be favourable to the maggot, while dry weather and hot sunshine reduce the severity of the attack.

BALLOU, H. A.—"The Scarabee of the Sweet Potato." Reprinted from the 'West Indian Bulletin,' Vol. X., No. 2, pp. 180-96, 1909.

The so-called 'Scarabee' is a weevil (*Cryptorhynchus batatæ*). The insect breeds in the tubers of the sweet potato. "For several years past this pest has been very troublesome in potato fields in Barbados, and the loss to the planters and small cultivators has been very large." Both laboratory and field experiments failed to give any successful method of treatment. The insects appear to be "very resistant to the effects of Vaporite." Rotation of crops is recommended.

SWEZEY, Otto H.—"The Hawaiian Cane Bud Moth (*Ereunetis flavistriata*)." Div. of Entom, Bulletin No. 6, 1909.

The insect belongs to the family *Tineidæ*. It is said to be invariably present in the cane fields of the Hawaiian Islands. It is normally not particularly injurious, but, when very numerous and when attacking soft varieties of cane, it may cause some trouble. Remedial treatment is not considered necessary.

GOWDEY, C. C.—"Cacao Fruit Fly, (*Ceratitis punctata*, Wied.)." The maggots of the fly feed upon the pulp surrounding the seeds of the cacao fruit, preventing the normal development of the seeds. The use of poisoned baits is recommended.

NEWELL, Wilmon.—"Measures Suggested against the Argentine Ant as a Household Pest." Reprinted from the 'Journal of Economic Entomology,' Vol. II., No. 5, 1909.

This ant (*Iridomyrmex humilis*, Meyr.) has become a great nuisance as a household pest in the United States. A useful repellant is noticed, viz., tape that has been soaked in a saturated aqueous solution of Corrosive Sublimate, and subsequently dried. If such poisoned tape is tacked or tied round the legs of tables, the ants will not cross the barrier. Syrup mixed with arsenic is a useful bait. When a certain number of the insects have fallen victims to the poison, the colony appears to consider the neighbourhood unhealthy and to vacate the premises. In winter,

they may be trapped by placing boxes of fermenting vegetable matter in the garden. The insects flock to the warm retreat and may be periodically destroyed.

CHITTENDEN, F. A.—"Control of the Mediterranean Flour Moth by Hydrocyanic-Acid Gas Fumigation," 1909.

Describes extensive (and apparently successful) operations in freeing flour mills from this troublesome pest.

FULLAWAY, David T.—"Insects of Cotton in Hawaii," 1909.

Gives particulars of all the principal enemies of the Cotton plant in the Hawaiiam Islands, with directions for remedial treatment. Many of the species here described occur also in Ceylon.

HUNTER, W. D.—"Hibernation of the Mexican Cotton Boll Weevil." U. S. Department of Agriculture, Bulletin No. 87 (Bureau of Entomology), 1909.

Describes the conditions favourable to the hibernation of the insect, and recommends "the destruction of stalks in the fall, as long as possible before the normal hibernation time."

WEBB, J. L.—"Some Insects Injurious to Forests. The Southern Pine Sawyer." U. S. Department of Agriculture, Bureau of Entomology, Bulletin No. 58, Part iv, 1909.

The insect in question is *Monohammus titillator*, one of the Longicorn beetles. It attacks felled or injured pine trees, ruining the timber. "Approximately 25 per cent. of the lumber in each log infested by the 'sawyer' is seriously damaged." The larvæ at first live in and feed upon the soft inner bark. During this stage, damage to timber may be prevented by stripping off the bark. Immersing the logs in water kills the insects after they have entered the wood.

PRATT, H. C.—"Notes on *Termes Gestroi* and other species of Termites found on Rubber Estates in the Federated Malay States," 1909. Department of Agriculture, F. M. S., Bulletin 1, 1909.

A general description of the commoner Termites of the F. M. S., with special observations on *Termes gestroi*. The key to the determination of the species, on page 4, is rather too vague to be of much assistance to anyone outside the country concerned, but may possibly suffice for purposes of differentiation, for persons who are in a position to examine the living insects on the spot.

PRATT, H, C.—"Observations on *Termes Gestroi* as affecting the Para Rubber Tree, and Methods to be employed against its Ravages." Department of Agriculture, F. M. S., Bulletin 3, 1909.

Gives useful directions for eradicating the insects when present, and for safeguarding the trees in unattacked areas.

SANDERS, J. G.—"Catalogue of Recently Described Coccidæ—II." U. S. Department of Agriculture, Bureau of Entomology, Tech. Ser., No. 16, Part III.

Mr. Sanders has taken up the useful task of supplementing the invaluable "Catalogue of the Coccidae of the World" published by Mrs. Fernald in 1903. A very large number of new species has been discovered and described since that date. Mr. Sanders brought out his first supplementary catalogue in 1906. The author "believes the list (now published) to be quite complete to March, 1909, and asks the assistance of co-workers in adding references which may have been overlooked."

SANDERS, J. G.—"The Euonymus Scale (*Chionaspis euonymi*, Comst.)". U. S. Department of Agriculture, Bureau of Entomology, Circular No. 114, 1909.

"The most serious enemy of the various species and varieties of Euonymus in the eastern United States." The circular specifies the various host plants and the distribution of the insect. A well-illustrated description of the species follows, and is supplemented by full directions of remedial treatment.

HOPKINS, A. D.—"Insect Depredations in North American Forests." U. S. Department of Agriculture, Bureau of Entomology, Bulletin No. 58, Part V., 1909.

The present bulletin serves as a summary of facts and results given in the several previous circulars by the same author on the same subject.

SWEZEY, O. H.—"Army Worms and Cut Worms on Sugar Cane in the Hawaiian Islands." Div. of Entomology, Bulletin No. 7, 1909.

Describes, with excellent illustrations, eight species of Army and Cut worms out of the thirty-five species known in the Hawaiian Islands. Some very interesting facts are brought out in the section dealing with natural enemies. The author finds that one kind of Tachinid fly, instead of the usual method of laying its eggs in or on the body of the caterpillar, deposits them upon the leaves of the food plant. These eggs are then eaten by the caterpillar, and develop into maggots in its intestinal canal.

MISCELLANEA: CHIEFLY PATHOLOGICAL.

BY T. PETCH, B.A., B.SC.

The fact that our common root diseases in new clearings usually spread from jungle stumps is now generally admitted, and the possible danger attending the tropical method of opening estate is beginning to be recognised. But any alteration in this method is rendered impossible, first by the cost of removing stumps, and secondly by the need of planting as soon as possible in order to shorten the compratively long period which must elapse before the estate becomes remunerative. Further, in temperate climates, where machinery is employed, the land must be completely cleared before it can be worked, but in Ceylon, at least, under present conditions, where level land is not available, this necessity cannot exist.

It has been recently proposed that, in order to avoid the danger of root disease, estates should be planted, when first opened, not with the product which it is intended to cultivate permanently, but with some other plant which can be grown for three or four years with a reasonable prospect of profit and then cut out. In this way, the jungle stumps would be given time to decay, and any root diseases which might arise would attack only the temporary crop. These diseases could then be dealt with as drastically as wished, without any hesitation on the ground of permanent loss. The land would then be clear of disease and be planted up permanently.

Though this method would certainly diminish the risk of root disease, it is rather too much to assume that all root fungi would be got rid of. Some of them can live independently in the soil, while others require no more than dead leaves, or a few chips, to enable them to begin their growth. Apart from this, however, the method will scarcely recommend itself to the rubber planter of the present day who wishes to see some return for his money as soon as possible, and he will without doubt continue to take the risk of root disease rather than add four or six years to his enforced waiting period. And it must be admitted that the comparatively small losses from root disease in Ceylon justify his attitude.

But the proposal immediately suggests the question, how long does it take jungle stumps to decay; and to this question no answer can be given, though it would be thought that sufficient data would surely be available in a country where so much jungle has been felled and cleared. No one, however, has been sufficiently interested to take notes, and therefore information on the subject is necessarily vague. The question itself is of course somewhat vague, since the time of decay must depend on the kind of stump, the elevation of the district, and to a great extent on the weather. And if the stumps are attacked by white ants, their duration is considerably briefer than would be the case under other conditions. Yet granting all that, it should be possible to fix approximately the time which a planter would have to wait if he adopted the scheme outlined above.

Probably few people outside the small band of fungus collectors have any idea of the length of time for which stumps persist. Certainly few others have any incentive to make observations on the subject. A dead stump is a garden of fungi, and hence a mycologist, if he takes any interest in the subject outside his laboratory, devotes special attention to them. When he collects in a limited area he comes to know the exact location of each stump, knows what fungi grow regularly on each, and in many cases hands on his knowledge to the next generation. In temperate climates, at least, he would be very much surprised if on making his usual rounds he found that some of his pet stumps had disappeared otherwise than by the hand of man.

It would appear that, given the maximum amount of assistance by white ants, the stumps of soft-wood trees, may decay fairly completely in about four years in a wet low country district. On a rubber clearing in the Kelani Valley most of the stumps had been attacked by white ants and were in an advanced state of decay in the fourth year.

In the Matale district, the stump of a 10-year-old Hevea tree was barely recognisable at the end of four years; this tree had however been killed by root disease, and consequently the main root would be partly decayed before the tree died; as it was subsequently attacked by white ants, the conditions were extremely favourable for rapid decay in this case. Hevea must be classed with the soft-wood trees, and it is probable that at least six years would be required for the decay of such a stump, if originally sound, in that district. The stumps of two trees which were felled at Peradeniya in 1903 have provided successive crops of fungi for the last seven years; they have been attacked by white ants to some

extent, but the greater part of each still remains, and the wood which is left is quite hard; one of these is a sapu, and the other probably *Filicium decipiens.*

The stump of a jak tree which was felled at Peradeniya, in 1900, was dug up in 1907; the wood was quite sound except on the exterior, and though it had been attacked by termites, they had not been able to make much progress. An extreme instance was noted in a case of root disease recently investigated; the field was covered with old stumps of "Na" (*Mesua ferrea*), and the disease was apparently associated with these stumps which were said to be fourteen years old. The exterior sap wood had decayed but the heart wood was quite sound, and the task of cutting off a side root five inches thick occupied two coolies for more than an hour. Apparently these stumps, though subject to a rainfall of about 200 inches per year, at an elevation of 1,500 feet, are likely to persist for at least another fourteen years.

I have not been able to collect further data. Stumps are of course available, but the date of felling and the kind of tree are usually not definitely known. But the evidence points to the conclusion that on the average, under favourable conditions, "soft wood" stumps may be expected to decay in from four to six years, while "hard-wood" stumps may persist for twenty years or more. Unfortunately most of our jungle trees are hard-wood trees, and two of our Hevea root fungi, *Fomes semitostus* and *Sphærostilbe repens*, usually originate from a hard-wood stump, viz. Jak.

One of the advantages which have been urged in favour of open planting of Hevea was conspicuously demonstrated during a recent attempt to infect some Peradeniya trees with "Canker." That fungus spores blow everywhere has been brought forward in support of the erroneous theory that as far as diseases are concerned there can be no difference between wide and close planting. But, through ignorance of general mycology, this objection loses sight of the fact that it is not so much a question of whether fungus spores will arrive at any given spot as whether they will find conditions favourable for germination when they get there. The trees in question form a group of thirteen planted on the river-bank, in a double or triple row, eight or nine feet apart; they have been referred to as affording evidence of the good growth which may occur when Hevea is planted at that distance, but the reference is obviously misleading, since only two of them are hemmed in by their neighbours. An attempt was made to infect these trees, on recently-tapped surfaces, with bacteria and with *Nectria* spores during the last monsoon; it was found that the stems remained quite dry during the rains, owing to the protection afforded by their leafy crowns, and in order to imitate the usual estate conditions, special arrangements had to be provided to keep the inoculated stems damp. The difference between these trees and the ordinary estate trees whose stems are constantly wet during the rains was most marked, and was probably sufficient to account for the failure of the inoculations.

It has been suggested that if Hevea is periodically defoliated by heavy rains in the south-west monsoon, as stated in the *Tropical Agriculturist* for February last, the "wintering" period may ultimately be changed from the dry season to the wet season. Observations on this point would be welcome, but at present it appears that the "wintering" of such trees takes place at the normal period, so that the trees are defoliated twice in the course of the year. The effect of this is a diminution of the store of reserve food in the tree. The new leaves are constructed from the reserve material of the tree, and if the tree is defoliated twice, there is a double drain on its stock. Professor Fitting has shown that when the tapping wounds are being healed, the tree draws on its stock of reserve food; from this it may be deduced that the amount of food which is being manufactured by the leaves of the tree at any time is insufficient to provide for the formation of the renewed bark. It is conceivable, therefore, that the extra defoliation might affect the bark renewal, but as the amount of reserve food in a Hevea stem is usually large, this inference is probably too small to be of practical importance.

It should not be forgotten that when a five-year-old Hevea tree is first tapped, it has the accumulated reserve of five years on which it can draw for bark renewal. During the four years' tapping (on a four-year system) this is being continually drained, and if the renewed surface is immediately retapped in the fifth year, the amount of reserve food then in the stem may be too small to admit of rapid renewal. Professor Fitting's opinion may be quoted. "Whether or not it is feasible with

regard to the future life of the tree, to commence the fifth tapping period a year after the initiation of the fourth, should in my opinion be made to depend on an investigation of the food distribution in the stem. It would be necessary to sacrifice two or three trees for this purpose, and to get an expert botanist (probably at some experimental station) to make an investigation of the distribution of starch in the wood and bark on the tapping area. If the reservoirs in the wood and bark have been refilled, there can be no objection to the continuation of tapping, provided that the latex exuding during the fresh tapping period satisfies in quality and quantity all fair demands. If, however, the quantity of reserve material in the stem proves to be as yet too small, it will be for the expert to decide how long the tree must be "rested" after the fourth tapping period. These examinations ought to be repeated "at least every four years, at the end of each fourth tapping period." It follows that the recent dictum, "a rubber tree which is not being tapped is not a whit better than one which is being judiciously tapped," is not in accordance with even our present knowledge, for the judicious tapping involves a drain upon the reserve food in the stem.

MISCELLANEOUS USEFUL PRODUCTS.

A USEFUL LEGUMINOUS PLANT.

(From the *Agricultural News*, Vol. VIII., No. 200, December, 1909.)

In *L'Agronomie Tropicale* for September, 1909, there is an account of a leguminous plant, *Tephrosia purpurea*, which deals with its suitability for the purpose of keeping down weeds in rubber and coffee cultivation.

For some time the investigations of physiologists and agriculturists have called attention to the disadvantages of weeding (in rubber and similar cultivations), but changes of methods in this direction have not been adopted by many planters; few experiments have been undertaken in connection with it in the truly practical sense.

Interest has, however, been awakened, and experiments with leguminous and other plants have been made to a certain extent everywhere. There have been attempts in many regions, to introduce a plant which, while capable of keeping down others which are harmful, enriches the soil and does not do any harm to such trees as rubber. According to a planter in the Federated Malay States, *Tephrosia purpurea* fulfils this purpose admirably. This *Tephrosia* grows slowly at first, but toward the end of four months it attains the dimensions of a small bush; it then commences to show superiority over other plants. When fully grown it is 9 to 11 feet high. In plantations it forms hedges across which no other plant can pass, and the necessary weeding near the plants costs little. The hedges are sufficiently distant to allow the air to circulate between the trees, and the soil is always well shaded and kept in good physical condition. As for the protected trees, these appear to make as good growth as they do on soil that is completely and regularly free from weeds.

By growing the plants of *Tephrosia* in hedges, a better circulation around the roots is assured, and the inspection of the protected plants is facilitated; other methods of cultivation have their advantages, however, as for example, that in which each rubber tree is surrounded by *Tephrosia*.

The plants attain a certain height, and should be cut once or twice a year; but this development gives them an advantage in combatting lalang and other tall weeds, and as they do not climb, they may be planted without inconvenience near rubber and coffee trees. In addition, *Tephrosia purpurea* is a plant which enriches the soil, has few natural enemies, is very hardy and propagates itself when it is once established.

The account goes on to show how a great saving in the expense of weeding follows the adoption of this plant in rubber cultivations. It may be remarked that several species of *Tephrosia* are common in the West Indies; among these are "goat rue" (*T. cinerea*) and "Surinam poison" (*T. toxicaria*). Of these, the former is a loosely spreading undershrub, which tends to run along the ground; stem 1 to 1½ feet long, leaflets ½ inch to 1 inch long; flowers about ½ inch long, red, appearing in February to June; pods spreading, with 5 to 10 seeds; found in open spaces, thickets and on the sea-shore. *T. toxicaria* is an upright, larger plant, with an erect stem about 4 to 5 feet high, leaflets 1½ to 2 inches long; flowers 2/3 inch long and over, blue; pods about 2 inches long.

OBSERVATIONS ON WILD LEGUMINOUS PLANTS.

(From the *Agricultural News*, Vol. VIII., No. 199, December, 1909.)

Some interesting facts are brought forward in Circular No. 31 of the Bureau of Plant Industry of the United States Department of Agriculture, with regard to the way in which virgin soils have gained their high nitrogen content. The following is abstracted from the circular to which reference is made:—

Many hypotheses have been formed to account for the large stores of nitrogen in virgin soils, but none of these have been entirely satisfactory. It seems to be a well established fact that small quantities of ammonia are collected from the air by rain and added to the soil; also, that more or less nitric acid is formed by electrical discharges and added to the supply. Some investigators have attributed the fixation of nitrogen entirely to the latter cause. Recently a number of efforts have been made to show that nonsymbiotic, or independent, bacteria are the chief agents in fixing this element. While it seems certain that some nitrogen is added to the soil by each of these methods, it appears to the writer that there is not sufficient evidence to warrant a conclusion that any one of them has been the most important factor in this work. They do not furnish a satisfactory explanation of the presence of such large quantities of nitrogen in the soil.

Several experimenters have suggested that wild legumes may have played some part in this work; they have not generally been considered as important factors. The studies reported in this circular indicate that this subject deserves more thorough investigation than it has yet received, and that native legumes have been of much more importance in this rôle than has been thought.

Several years ago the writer raised the question as to whether the native legumes of the prairies were sufficiently numerous to have fixed the amount of nitrogen present. A search for published data on the subject was made, but none were found. Accordingly, in the spring of 1908 a series of investigations was begun, a preliminary report of which is here given.

The writer had long been familiar with the flora of this region, but was not at all prepared for such results as were found. The average numbers of wild leguminous plants per square yard, that were found, were: ordinary ground 17, high plains 3·6, and sandhills 8·4. After the grasses (including sedges) and possibly the composites, legumes form a larger part of our flora than does any other group of plants. If these figures are representative, or anywhere near it, it is evident that our farm lands from time immemorial have been growing a full stand of legumes. Seventeen plants to the square yard are enough to fill all the soil with their roots. Most of these plants, such as Amorpha, Kuhnistera and Psoralea, have enormous root systems (and these genera represent the large majority of the prairie legumes). A single plant is often sufficient to fill the soil with its roots for a radius of several feet, as any farmer who has ploughed up Amorpha is ready to testify. The smallest root systems are probably those of Vicia and Lotus, and yet seventeen of these to the square yard would seem to be sufficient to gather a large supply of nitrogen.

Many examinations were made to ascertain the prevalence of nodules upon different species. Large numbers of tubercles were found on every species examined, and on nearly every individual except mature Kuhnistera. Nodules are especially plentiful on Psoralea, Astragalus, Acuan, Meibomia, and Lotus. On Lotus the nodules are often almost massed together on the tap-root. Some difficulty was experienced at first in finding tubercles on Kuhnistera, but they are always in evidence on seedlings. On the old plants there is a doubt whether typical nodules are produced, or whether the bacteria are in the small, thickened roots which occur in extraordinary numbers, almost in fascicles, especially on roots of the previous year's growth. During the coming season an effort will be made to determine this point. The efficiency of these legumes as nitrogen gatherers does not seem open to question, however, if the universal inoculation of the seedling plants is considered.

It does not seem that most of these legumes choose the poorer soils, for, in fact, many of them grow much better on rich soil; but when the soil becomes rich in nitrogen and humus, other plants which do not thrive on poor soil are able to crowd out the legumes. There is good reason to believe that lands that are now richest formerly supported the densest leguminous growths, except, perhaps, where the plant food has been washed down from higher levels.

Western farmers have been slow to learn their lessons from Nature. Nature on her farm has kept up the production

of grasses and other nitrogen robbers by the constant growth of legumes. If this fact had been recognized sooner, perhaps there would not have been such reckless exploitation of the rich soils of the Mississippi basin. For forty years farmers have lost sight of this, and have taken off grain crops (all grasses) continuously, and doubted if this practice would ever exhaust their soils, because they were still productive after the removal of twenty, thirty, or forty crops. But now the effect is evident; farmers must learn from the prairies round them one of the first principles of permanent agriculture, and introduce leguminous crops into the farm rotation.

LIVE STOCK.

IMPROVEMENT OF CATTLE.

By R. C. WOOD,
Deputy Director of Agriculture,
Northern Division.

(From the *Madras Agricultural Calender*, 1910.)

This article is about cattle, and will show the ryot how he may improve his cattle by making up his mind to keep fewer of them, so that those he has may be better looked after and consequently stronger and more useful. Anyone who travels through the country by road will see, especially in the mornings and evenings, great herds of cattle going out to graze or coming back to the village. These herds consist of cows, heifers, old bullocks and young bulls of all sizes and qualities, who pick up a precarious living in the fields and on the public grazing lands belonging to the village. Except in the rainy season, there is never sufficient fodder for all, with the result that these animals are generally very thin and in poor condition. Why then are they kept? There are several reasons. Firstly, they supply cowdung. This substance is unfortunately used for many purposes besides that of manure. It is made into bratties, dried and used for fuel, smeared on walls, floors and baskets and in a variety of other ways. In many villages, too, the wealth and general position of the ryot is gauged by the number of cattle he keeps, so that not to be the possessor of a number of cattle, however bad their quality, is looked upon as a disgrace, and it is difficult to make people see what a false idea this is. The value of the hides and horns of these animals must also be considered, though in this respect they are probably less valuable than the goat, especially as the animals are often branded, a process which reduces the value of the hides. The milk given by the cows is extremely small in quantity, and is generally given to the calf, though in some cases the cows are milked before they go out to graze, and often when grazing is good the ryot sends his superior cattle, those he keeps for breeding and for supplying his household with milk, out along with the inferior animals. Lastly, the animals when grown up, often become the working and ploughing cattle, especially in villages where the grazing is comparatively good, though in many cases they are too small to be used in this way. We have seen then that there are advantages attached to this system, and before condemning it, we must consider whether the disadvantages outweigh them. The main and obvious fault that is at once evident is that the food supply is insufficient, and that more animals are being kept than there is food for. So great is the demand for food and so closely is all the available grass eaten down, that in times of scarcity even the working cattle are starved or insufficiently fed. This is disadvantageous in two ways. First, every animal at some time in its life is improperly nourished, and if once an animal suffers severely from starvation, especially when young, it can never grow into a sound healthy strong bullock or a good milking cow. The secret of breeding good cattle is to keep their growth steadily progressing, without a check at any time. Furthermore, this very close grazing reduces the fertility of the land in many ways, by (*a*) lessening the quantity of organic matter which ought to be ploughed into the fields, (*b*) keeping the natural vegetation down, and thereby lessening the amount of material which could be used as firewood and thus permit more of the cowdung to be used as manure, and (*c*) keeping the land bare and thus subject to wash in times of heavy rainfall.

A second great defect in this system is that careful breeding, that is the making of suitable cattle in order to produce good offspring, is prevented. The village grazing grounds are public, and every one has a right to send his cattle there. The custom of not castrating bulls—in some districts not at all, in others not until after maturity—

results in cows being covered by unsuitable and immature bulls, and thus tends to reduce the general standard of the village cattle.

The third great risk in this system is that disease is very easily spread and very difficult to check when once it gets into a village. A man brings a cow from another village, which may already be suffering from rinderpest or some other disease, but which does not yet show it, and this cow on being turned out in the public grazing lands may infect many of the village cattle and cause a tremendous loss to the village before the disease is stamped out. It will be seen that the disadvantages very considerably outweigh the advantages, and that the system is not a good one. How may it be stopped? *Reduce the number of cattle and improve their quality.* The ryot must have bullocks to cultivate his fields, and if fewer animals are kept, then they must be able to do better work. They need not necessarily be larger or fatter animals, but must be well formed, with good chests, straight and strong legs and well shaped feet. Such will never be obtained if all the cattle are permitted to graze together, and the young male stock are left uncastrated. Under the present arrangements, the level of the common herds is so low that no one cares how the animals are bred. This is a great mistake. If a Brahminy bull is kept, he should be picked with the utmost care, and on no account should a badly made animal be used for the purpose. Having decided on him, all the rest of the male stock in the village should be tied up under control or castrated before they are one year old. It is supposed that if this operation is deferred until they are three or four years old, the animals will be stronger, but there is no truth in this. The operation of mulling or crushing the testicles is often improperly performed; it is better to remove them entirely. If the numbers of his cattle are to be reduced, the owner must see to it that all his cows are very useful and able to breed good working cattle, which will plough his lands, or work his mhote as efficiently as the cattle he sometimes has to purchase at great cost from other districts. These cows should not be kept too fat, and should be allowed some excercise every day, if possible.

To conclude, it will generally be admitted that the best cattle in Southern India come from Ongole, and yet this district has no peculiar advantages in the size or the quality of its public grazing lands. It is the custom, however, for each ryot to keep his own cattle tied up or grazing in his own fields, while if they need grass, it is cut and brought to them. The breeding bulls are carefully picked, and the cows are never allowed out in large herds along with inferior bulls. The calves are fed well when young.

If these customs are introduced into other parts of the country, there is little doubt that improvement would rapidly follow.

RINDERPEST OR CATTLE PLAGUE.

BY F. R. BRANDT,
Deputy Chief Veterinary Officer.

(From the *Agricultural Journal of British East Africa*, Vol. II., Pt. 3, October, 1909.)

Definition—A special and highly contagious fever, characterized by sudden invasion, rapid advance, rise of temperature, constitutional disorder, congestion of all mucous surfaces especially of the digestive tract, and an early and high mortality. Animals of the bovine species are most highly susceptible; antelopes, sheep, goats and swine are to a lesser extent.

History.—In the first century it was introduced into Western Asia by the Mongols, and since then has had a permanent home in China, India, and the Steppes of Russia. In 376 A.D. the Western movement of the Huns carried the plague from the Black and Caspian Seas to western Europe. Since that date the disease has followed in the wake of every European war in which Eastern natives were involved, or which necessitated the use of cattle from Eastern Europe. In this way it spread over the whole of Europe, reaching England in 1714, when the stamping out method was adopted with success. The war of the Austrian succession 1740 brought about a spread of Cattle Plague which caused a loss of more than 3,000,000 head of cattle in Europe. In the latter half of the eighteenth century another outbreak overran the whole of Europe except Norway, Sweden and Spain and carried off 20,000,000 head of cattle. The wars of Napoleon again brought about serious losses from Rinderpest. Since 1840, it is to the extension of Commerce, rapid transport, development of manufactures and consequent increased demand for beef, rather than to war, that outbreaks of Rinderpest have occured.

In 1865 it was brought to England by a cargo of cattle from the Baltic. It speedily spread all over England but

was eventually stamped out. In this outbreak England lost about 233,000 head of cattle. Further outbreaks occured in England in 1872 and 1877, which were speedily suppressed by slaughter of diseased and incontact cattle, and by rigorous disinfection.

In 1841 and 1865 Rinderpest was introduced into Egypt where it appears to to have died out until 1889, when it was introduced into Africa.

Capt. Lugard describes it as "Seeming to have started on the East Coast, opposite Aden, and to have spread inland. It began in the spring of 1889 but did not reach Ukamba and Masailand before the summer of 1890. It then spread through both these countries, Kavirondo, Uganda, Ankole and Unyoro, and by September, 1891, had reached the centre of Africa. From here it spread South to Nyasaland causing enormous losses among cattle and game. Nearly all the buffalo and eland are gone. The giraffe has suffered and many of the small antelopes. The pigs seem to have nearly all died."

In March, 1896, Rinderpest reached Bulawayo, and by the end of 1897 had spread over nearly the whole of South Africa. The stamping out method by slaughter was tried for some time, but was abandoned in favour of bile or serum inoculation.

Animals Susceptible.—Although bovine animals are by far the most susceptible, infection extends to all ruminants, camels and swine. The horse, dog, rabbit, bird and man are immune.

Cause.—The micro-organism which produces Rinderpest is one of the invisible viruses, as it is so small that it cannot be demonstrated by the microscope. The virus of Rinderpest is among the larger of the invisible viruses, since it will only pass through a Berkenfield filter which has an exceptionally thin wall. The ordinary Berkenfield and the closer textured Cumberland filter are of too close a texture to allow of the passage of the virus.

Susceptibility has a large influence on the cause of an outbreak of Rinderpest. Cattle are highly susceptible; yet in the Steppes of Russia, where the disease has for centuries had a permanent home, the native cattle mostly recover from an attack of the plague, while newly introduced cattle nearly invariably die. In a country where Rinderpest has been introduced, and no attempt been made to combat it, the susceptibility of the survivors of the outbreak and their progeny gradually decreases, until in course of time it becomes very slight; but to acquire this degree of insusceptibility Rinderpest must have been constantly present in the country. Sheep and goats are slightly susceptible. Immunity follows a first attack.

Modes of Infection.—Infection occurs in various ways. All the secretions and excretions of a diseased animal are infective, and Rinderpest is contracted not only by the direct contact of a healthy with a diseased, but by healthy cattle feeding in infected grass or being put in infected bomas.

The virus is carried in manure, hay, cattle trucks, meat, skins, and in fact by anything which has been in contact with a diseased animal. Wild game are instrumental in the rapid spread in unsettled countries.

Complete dessication destroys the infection; exposure of Rinderpest hides to strong antiseptics such as carbolic acid, Chloride of lime, Perchloride of mercury and sunlight for seven days renders them harmless. In manure, litter, stalls, mangers, etc., in a still and sunless atmosphere the virus retains its vitality for as long as three months.

Incubation.—In an animal infected with virulent Rinderpest blood the first rise of temperature appears about the third or fourth day. In animals which contract the disease by natural means the period of incubation is generally slightly longer. It largely depends on the strength and quantity of the virus and the susceptibility of the animal.

Symptoms.—The first symptom is a sudden rise of temperature which generally reaches a height of 104° to 108° on the third or fourth day.

At this stage there are no visible signs of sickness, but by the fifth day there is a dry staring coat, dullness, slight loss of appetite, tremors and twitching of the muscles behind the shoulders. Following these symptoms are drooping of the ears, dryness of the muzzle, a general redness of the mucous lining of the mouth, vagina, rectum and eyes. There is a discharge from the eyes which at first is slight and watery, becoming thicker and more profuse as the disease advances. The bowels are constipated at first and the faces are covered with slimy mucous. There is slight dribbling of saliva from the mouth and discharge from the nostrils.

As the disease advances these symptoms become more severe, appetite is lessened and rumination ceases, the animal stands with head and ears drooping, the coat is rough and staring, the

discharges from the eyes, nose and mouth become thicker and profuse, and the skin of the muzzle cracks.

At this stage grinding of the teeth is a constant symptom, and if the mouth is examined the mucous membrane is of a salmon pink colour, and in many cases white epithelial concretions are present on the inner sides of the lips, dental pad and gums. These concretions are of the consistency of cream cheese and have a bran-like appearance. They vary much in abundance, in some cases being very scanty, in others they cover the whole of the mucous membrane of the mouth. In some cases these bran-like concretions are absent, but small ulcers are present on the lips and dental pad. The mouth has invariably a peculiar fetid odour. Emaciation advances rapidly, the belly is tender and pain is manifested if it be pressed; the bowels which at first were slightly constipated become relaxed, and diarrhœa sets in about the second day after visible symptoms of sickness appeared. The fæces are at first greenish and later on become increasingly liquid, fetid and of a dirty brown colour. Straining is constant, and at a late stage the fluid fæces are very dark, usually contain blood and are discharged involuntarily, the anus becoming permanently relaxed; and tail and hind quarters are covered with the fæces which cause excoriation of the skin. The breathing is accelerated, with a clicking sound during expiration. There is always great thirst, the animal will remain close to water and drink frequently. Emaciation and loss of strength are rapid, and weakness is very marked, the animal staggering when walking. At a later stage the animal remains lying down and is too weak to rise. Death occurs either with convulsions or in a semi-comatose condition. The odour of an animal suffering from Rinderpest is characteristic.

In a virulent outbreak of Rinderpest death occurs from the sixth to the ninth day, but in countries where Rinderpest has a permanent home, or in which disease is dying out, the majority suffer a mild attack and recover, only those animals which are most susceptible contracting it. The probable cause of this is that the virus in passing through so many animals has become somewhat weakened.

In cases of this kind a common symptom is a skin affection which appears during the course of the disease. An eruption appears on the skin which dries, forming a sort of crust, and at various parts of the body—chiefly the face, neck, udder, thighs and arms—warty-looking growths appear.

Post-Mortem Appearances.—On examining the carcase of an animal which has recently died of Rinderpest the first thing noticeable is the peculiar fœtid odour, the body is much emaciated, the muzzle is cracked and covered with a dirty discharge from the nostrils, the eyes are sunken and the discharge from them adheres to the face scalding, the skin is scurfy, and the eruption and concretions may be present. The anus is soiled with dark-coloured liquid fæce which cover the tail and thighs causing erosion of the skin. A slimy mucous deposit covers the lining of the mouth, which is congested, swollen and detached in places leaving erosions of various depths; these are most common on the tongue, inside lips and dental pad. The barn-like concretions may be present, or the epithelial lining of the mouth may hang in shreds leaving low ulcerated looking patches. The membrane lining the nostrils is swollen and congested, covered with mucous, and abrasions and ulcers are present about the nasal openings.

The posterior part of the mouth (Pharynx and Larynx) are invariably highly congested, covered with slimy mucous, and ulcers of various sizes are present. On opening the carcase the lungs may be normal, though emphysema is frequently present.

It is in the abdominal cavity that characteristic lesions are manifested. The Peritoneum is congested and may be covered with small red spots; it usually contains some yellowish fluid. The first, second and third stomachs show but little change, though there may be some slight congestion and thickening of the mucous membrane.

The fourth stomach (abomasum) is invariably the seat of extensive lesions. The mucous membrane is much inflamed, especially that half of it out of which the intestines lead (Pyloric portion). The colour varies from blood red to portwine colour, the folds are much thickened, and ulcers are frequent in the Pyloric Portion. (These ulcers occur in other diseases also.) These ulcers are in different stages, some of them just commencing as small red spots, others of longer standing appear as dark eroded sores.

The small intestines are congested and inflamed. These lesions vary; in the majority of cases the entire lining of the bowel is covered with small red spots and a large amount of greyish

mucous deposit is present, sometimes to such an extent as to form casts of parts of the gut. This greyish mucuous deposit consists of mucous exudate and shreds of epithelium which is found detached over large patches leaving the surface red.

The large intestines are generally affected to a lesser extent; it is rare to find the entire surface in a state of inflammation. Patches of inflammation are the rule except in the last portion of the bowel (Rectum). This is often intensely inflamed with dark blood-stained longitudinal streaks. The epithelium is thickened and covered with the same muco-purulent exudate as is present in the small intestines.

The Liver may appear healthy in some cases but, as a rule, is congested and yellowish in colour. The lining of the gall bladder sometimes shows small patches of inflammation. The bile itself varies in quantity. In colour it may be light green, light brown, dark brown, or reddish brown. Its consistence may be very thin or thick and cury-looking. The spleen is usually normal. The Kidneys are congested. The urinary bladder, uterus and vagina are congested and thickened and a variable amount of mucous exudate is present.

Many of the above mentioned lesions may be absent, but in the *post mortem* examination of an animal suspected of having died of Rinderpest, the seats of constant lesions are the mouth, fourth stomach (abomasum) and intestines.

Treatment of Rinderpest.—Medical treatment is of little use and it is probable that in cases in which recovery has been attributed to drugs, the true reason is that the animal was either natuarlly somewhat resistant or the virus somewhat weakened. Even in a severe outbreak some recoveries occur naturally. In the case of valuable animals being attacked, and treatment decided on, good housing and hygienic conditions, a limited amount of drinking water and administration of gruel are more important than dosing with drugs, Intravenous injection of serum has a curative action in the early stage of the disease.

Diagnosis of Rinderpest.—Some of the symptoms of Rinderpest are found in other diseases, but all the symptoms described in conjunction with the rapid and fatal course, and the existence or introduction of cattle plague in the vicinity facilitate diagnosis.

The diagnostic symptoms are—sudden rise of temperature, bran-like concretions or ulcers in the mouth, reddened conjunctiva and discharge from eyes and nose, abdominal tenderness, fœtid diarrhœa, frequently containing blood, clicking sound during expiration, peculiar fœtid odour, rapid progress of the disease and generally fatal issue.

SCIENTIFIC AGRICULTURE,

THE DIRECT ABSORPTION OF AMMONIUM SALTS BY PLANTS.

(From the *Gardeners' Chronicle*, Vol, XLVI., No. 1194, November, 1909.)

A question of considerable scientific and also practical importance is discussed by Messrs. Hutchinson and Miller, of the Rothamsted Experiment Station, in a paper which appears in the current number of the *Journal of Agricultural Science*. The question to which Messrs. Hutchinson and Miller contribute a decisive answer, and which has been debated inconclusively during the last twenty years, is—are green plants able to take up nitrogen from the soil in the form of ammonium salts?

It is unquestioned that ammonium salts—sulphate of ammonia, for example —serve to supply plants with nitrogen. But, since nitrifying bacteria are present and active in most soils, and since these organisms change ammonium salts into nitrates, only direct experiment can determine whether the ammonium salts supplied to the soil are first changed by the agency of these organisms to nitrates, or whether salts of ammonium may be absorbed as such by the roots of plants.

General considerations, as well as previcus experiments, are in favour of the view that ammonium salts may be absorbed directly. Thus, it is well known that the soil under forests is deficient in nitrates, and hence it is assumed that the trees derive their supplies of nitrogen from ammonium compounds formed during the decay of humus.

The experimental grass plots of Rothamsted, manured for many years with ammonium salts, point to a similar conclusion; for the soil of these plots has become distinctly acid, and the nitri-

fying organisms in consequence much reduced in numbers. Hence it would appear that the nitrogen which the grass is obtaining is that of the ammonium salts of the manure. Inasmuch, however, as the experimental evidence supplied by previous workers is not conclusive, Messrs, Hutchinson and Miller have carried out a series of experiments, admirably planned and conducted, to settle the matter once for all.

The experiments, to be conclusive, must be carried out in soil or sand in which nitrification is precluded, and it is not the least interesting part of their work that the authors named have succeeded in growing various plants, such as Wheat and Peas, in media from which bacteria of all kinds were excluded. The seeds were first sterilised by means of mercuric chloride, they were germinated on sterilised agar, and, when sufficiently advanced, the seedlings were transferred to sterilised culture vessels containing soil, sand, or water, to which either ammonium sulphate or nitrate of soda, or both, was added.

The results prove that in the cases of Wheat and Peas, plants grow just as well when supplied with ammonium salts, under conditions which preclude all possibility of the nitrification of these salts to nitrates, as they do when provided with nitrogen in the form of nitrates.

Incidentally, Messrs. Hutchinson and Miller make an ingenious suggestion to account for the striking fact that leguminous crops are so much richer than others in organic nitrogen. They observe that plants supplied with nitrogen in the form of ammonium salts tend to be richer in nitrogen than those which receive nitrates. They suggest, very plausibly, that this is due to the ammonium salts being converted readily into organic compounds, such as asparagine, which substances will not interfere with further absorption of ammonium salts from the soil. When, on the other hand, nitrates are supplied, they tend to accumulate as such in the tissues of the plant, and a condition of equilibrium between soil and plant-tissues with respect to nitrates being established, further absorption of nitrates is hindered.

Applying these considerations to leguminous plants, they point out that the nitrogen supplied to the plant by the activity of the nodule-organism is probably in the form of an ammonium compound; that, as a matter of fact, asparagine occurs in considerable quantity in the tissues of the root neighbouring on the nodules; and, therefore, there is nothing to hinder the absorption by the plant of as much combined nitrogen as the nodule or organism is able to provide.

Lastly, turning to the practical side of the question, it appears to be fairly well established that not all crops are alike in their preference for a particular form of nitrogen. Potatoes thrive somewhat better when supplied with ammonium salts. Maize and Paddy Rice prefer ammonium salts during their early stage of growth, but later do better with nitrates. Mangolds and Buckwheat give a better yield when supplied with nitrates than when provided with sulphate of ammonium. Mustard, Oats, and Barley are indifferent, growing equally well with nitrates or ammonium salts.

Speaking generally, the best results are obtained when nitrogen is supplied in both forms. The last point deserves to be emphaised, for, as has been shown by Mr. Hall, the continued and exclusive use of one or other of the two chief nitrogen-containing artificial manures, nitrate of soda and sulphate of ammonia, sets up unsatisfactory soil conditions.

We welcome the work of Messrs. Hutchinson and Miller, both because of its intrinsic value and because it is a manifestation of the energetic manner in which soil and other researches are being conducted at Rothamsted under the able direction of Mr. Hall. We should like to see the investigation extended to embrace the chief garden and field crops, and would suggest that some of the horticultural colleges should carry out the work on the lines so excellently laid down in the paper which we have been considering.

It should be the function of a station such as Rothamsted to deal, as it does, with the broad principles of the sciences of agriculture and horticulture. It should be the function of the smaller institutions to develop in detailed manner the discoveries made at the national station, so that they may yield the maximum of service to those engaged in the practice of agriculture and of horticulture.

THE TREATMENT OF ACID SOILS FOR RUBBER AND OTHER CULTIVATIONS.

By J. B. CARRUTHERS.

(From the *Agricultural Bulletin of the Straits and F.M.S.*, VIII., No. 1.)

A series of experiments have been begun by the Department of Agriculture on some low lying flat land

which has abnormally acid soil, rendering it unfavourable for the rapid growth of root growth of rubber or other cultivated plants.

The presence of a too large proportion of acid in peaty soils is due to the existence of a large proportion of humic acid which is a brown or black substance produced by decaying vegetable matter. This decomposition is greatly facilitated by heat, air, and moisture, and by the presence of putrefying nitrogenous matter. The conditions in many clearings in Malaya are, therefore, specially suited to the formation of an excess of humic acid which exists in many places, to such an extent, that the roots of young rubber are not able to grow, and the plants grow without vigour and in some cases succumb.

Such soils are physically and in other respects most suitable for healthy and rapid growth of rubber, and when the amount of acid has been reduced, they often produce exceptionally fine rubber.

The question of the neutralisation of such soils in the shortest time is of great importance. The only method used at present is to allow the sun free access to the soil, and by this means and plentiful drainage to gradually eliminate a proportion of the acid.

This is, however, a lengthy and not always successful method, and a much quicker plan is to add such proportion of basic substance, such as lime, as is needed to neutralize the acid in the soil.

A very large supply of natural phosphate is being extracted from Christmas Island, and can be delivered comparatively cheaply at S. S. and F.M.S. ports.

This raw phosphate not converted into the superphosphate will be tried on acid soils. The advantage in using this manure is that the raw phosphate, *i.e.*, phosphatic rocks exactly as they are obtained in nature is cheaper than the manufactured superphosphate, and the acid in the soil of the superacid lands will convert the phosphate into superphosphate, and by so doing the soil will more rapidly lose its acid and become neutralized, and the available plant food in the soil greatly increased.

The costs of such an application of raw phosphate will be determined by experimenting with different quantities per acre to discover the smallest amount necessary to render the soil favourable to root growth of rubber.

In certain cases the lack of vigour in the growth of young rubber on acid soils has been attributed to dampness of soil, fungi or other diseases of the roots, and it will be well if in cases where there is reason to suspect that the chemical condition of the soil is the cause of the lack of progress of rubber plants, a portion of the field be treated to reduce the acidity.

On some of the super acid soils a litmus paper pressed against a handful of the damp soil gives in a short space of time, some few minutes, a marked acid reaction, *i.e.*, is changed to a pink colour. This may be used as a rough test of the relative amount of acidity in the soil.

MISCELLANEOUS:

LITERATURE OF ECONOMIC BOTANY AND AGRICULTURE.

BY J. C. WILLIS.

Kapok:—

- Contribution á l'histoire botanique des Kapokiers. See Bot. Centr. 150, p. 450.
- Le Kapok aux Philippines. Journ. d'Agr. trop. June 1908, p. 187.
- Kapok en Kapok-onderzoek. Ind. Merc. 21, 7, 1908, p. 533.
- Some photographs of the silk cotton tree, and remarks on early records in America. Jam. Bull. 1907, p. 63.
- Der Baumwollenbaum, Kapok. Der Pflanzer, IV. II. 1908, pp. 289, 305.

- Le Kapok au Gamboge. L'Agric. pratique des pays chauds, Feb. 1909, p. 166.

Kokoona:—

- Bark of Kokoona zeylanica. "T.A." Nov. 1905, p. 697.

Kola:—

- Kola in West Africa. W. Ind. Bull. 7. 1907, p. 338.
- Le Kolatier en Guinée. Bull. Jard. Col. 1907, p. 400.
- Kola Cultivation at the Gold Coast. Trop. Life, June 1907, p. 84.
- Conservation et sterilisation des noix de Kola fraiches. Trav. Lab. Mat. Med. V. 1908.

Sur la composition chimique de s noix de Kola. do.

Sur la composition chimique et l'action phycodynamique de la noix de Kola. do.

Bernegau. Studien uber die Kolanuss, Tropenpfl. 12, 1908, p. 117.

Note sur le Kolatier au Gabon. Bull. Jard. Col. June 1908, p. 521.

Studies on the Kola nut (abstr. by J. C. Willis) "T.A." May 1908, p. 450.

Bernegau, Zur Kolafrage. Tropenfl. 12, 1908, p. 464.

Zur Kola-Kultur in Kamerun. Tropenpfl. 5, 1909, p. 230.

Note sur la Cola L'Agr. pract. des pay chauds, April 1909, p. 341.

Die Konservierung frischer Kolanüsse. Tropenfl. Aug. 1909, p. 391.

Lac :—

A note on the lac insect. Stebbing. Ind. Forest Records I. 1, 08.

The shellac industry. Ind. Agric. 1, 6, 1908, p. 180.

On the gum lac insect of Madagascar. Hewstead. Q. J. L'pool, J. C. R. Jan. 1908, p. 3.

Lac products in India. "T.A." Sept. 1908, p. 213.

Shellac. Watt. Chem. & Drug., Nov. 1907, p. 775.

Lac and Indigo. Ind. Agric. Dec. 1908, p. 371.

Lac in the Eastern Dun. "T.A." March 1909, p. 216.

Revolution in the lac industry. Ind. Tr. Journ, April 1909. "T.A." June 1909, p. 513.

The cultivation of shellac as an agricultural product. Agri. Journal of India, July 1909, p. 258.

Lagetta :—

Lacebark tree of Jamaica. Agr. News, 8, 8, 1908, p. 255. "T.A." Dec. 1908, p. 517.

Lantana :—

Le Lantana et sa destruction. Bull. Jard. Col. July 1907, p. 70.

Is lantana a curse or a blessing. Ind. Forester, Aug. 1907, p. 369.

The Lantana shrub. "T.A." Supp. Dec. 1907, p. 138.

A suggested use for Lantana. do, p. 138.

Lawsonia :—

Oil of Lawsonia alba. Hooper, Journ. As. Soc. Bengal IV. '08, p. 35.

Lemongrass Oil :—

Lemongrass oil. "T.A." Feb. 1907, p. 67.

Lemongrass. "T.A." Nov. 1905, p. 671.

A new adulterant of lemongrass oil. "T.A." Dec. 1905, p. 762.

See Schimmel's Reports.

Du dosage de citral dans l'essence le lemongrass. Bull. Ec. Indoch. 1907, p. 783.

Cymbopogon citratus.—Stapf. Hooker's Icones, tab. 2826.

De citralbepaling in Lemoengrasolie. Korte Ber. 50, 1908.

Lemongrass oil. Ind. Agric. Jan. 1908, p. 15. "T.A." May 1908, p. 421.

Lemongrass and citronella in the Seychelles. "T.A." Dec, 1907, p. 410.

Notes on Cochin Lemon Grass Oil. W. I. Bull. IX. 3, p. 265.

A note on Cochin Lemon Grass Oil. do. p. 278.

Logwood :—

Bastard logwood. Agri. News. 29, 6. 1907, p. 203.

Lophira :—

Niam fat. Chem. & Drug. 7, 12, 1907, p. 873.

Seeds of Lophira alata from Sierra Leone. Bull. Imp. Inst. VI. 1908, p. 243.

CEYLON AGRICULTURAL SOCIETY.

MINUTES OF MEETING HELD ON FEBRUARY 7TH, 1910.

Minutes of the 50th Meeting of the Board of Agriculture, held at the Council Chamber on Monday, the 7th February, 1910, at 12 noon.

The Hon. Mr. H. L. Crawford, C.M.G., Controller of Revenue, presided.

There were also present :—The Hon. Messrs. S. C. Obeyesekere and A. Kanagasabai, Dr. H. M. Fernando, Messrs. R. H. Lock, James Peiris, F. L. Daniel, W. A. de Silva, Tudor Rajapakse Mudaliyar and C. Drieberg (Secretary).

Minutes of the meeting held on December 18th, 1909, were read and confirmed.

Progress Report No. 48 was adopted.

Statements of Expenditure for December, 1909, and January, 1910, were tabled.

Mr. Lock briefly referred to the progress made in regard to the tobacco experiment at Maha-iluppalama.

The Hon. Mr. Kanagasabai submitted the Report of the Committee on Model and Experimental Gardens and formally

moved its adoption. The Hon. Mr. Obeyesekere seconded the motion, which was carried. With the omission of the name of the Hon. Mr. Bernard Senior, the same Committee was appointed a permanent Advisory Committee on Model and Experimental Gardens, viz., Mr. R. H. Lock (Chairman), Hon. Mr. Kanagasabai, Dr. H. M. Fernando, Sir Solomon Dias Bandaranaike, Messrs. W. A. de Silva, W. D. Gibbon and C. Drieberg (Secretary).

Mr. Lock read a paper on "Weeds," and in the discussion which followed the Chairman, the Hon. Mr. Obeyesekera, Dr. H. M. Fernando, and Mr. W. A. de Silva took part.

C. DRIEBERG,
Secretary, C.A.S.

A MANUAL ON DRAINING.

(*Contributed.*)

"If you have good soil on your estate, try and keep it," was the advice of an "old hand" to a young planter, asking his opinion on the subject of draining. In a country where such heavy rains are the rule, this is no easy matter, but everyone can take such steps on his place as to reduce washing away of the soil to the minimum.

It may be said this advice comes somewhat late in the day, that draining a Tea estate that has originally been badly drained, would be "locking the stable door after the steed is stolen," the best reply to this is another adage, equally appropriate, "better late than never."

There are manuals on pruning and manuring, helpful and valuable, but, as far as I know, none on draining, and yet the retention of the soil is of even greater importance, and should come before the improvement of the soil.

If late in the day for Tea, a manual may possibly be found of some assistance to the younger hands now engaged in opening for Rubber, and in these days when high cultivation and manuring is so extensively carried on, it is of the greatest importance that the land should be well drained, otherwise much of the expensive manure must get washed away in the heavy plumps of rain which are so frequent, and which often cause such terrible damage, damage that is irreparable. The fine results from some favoured districts in Ceylon, are, I should think, to a great extent attributable to the lower and better distributed rainfall, the land being on that account less subject to wash than in other less favoured districts which suffer from excess.

I remember seeing a clearing being opened above a cart-road, (the district need not be mentioned,) which was an object lesson of the necessity for prompt attention to draining. It had been planted before draining, but unfortunately for the Proprietor, one of these torrential thunder-plumps came down, and simply washed the land bare. The side-drain on the cart-road was choked, and the road itself inches deep in soil, the very cream of the land. I wonder if the Proprietor realised what he lost on that occasion, a loss he could never replace. A few drains to intercept the rush of water down the slope would have saved tons and tons of valuable surface soil.

In the Coffee days it was considered sufficient to have drains about 50 feet apart, but in course of time, when the land got bared of the roots and stumps of jungle trees which held the soil together, this distance was too great, and most estates, when they were planted up in Tea, were inter-drained, making the drains 25 feet apart, which is about right.

The first thing after burning off a clearing is the tracing and cutting of the roads and drains. For the former a gradient of 1 ft. in 20 ft. is best, that is, in ordinary land, a steeper trace often causes gutting of the drain. If, however, the land be steep, the roads should be traced at a greater gradient in order to get over the ground. A road at an easy gradient on steep land means a lot of walking and little ground covered.

As to the way of tracing the roads, the starting point should, of course, be the terminus of an existing road, and, as far as possible, roads should be equidistant, but this depends on the nature of the land. You can hardly have too many roads, and they should always be kept in good order. To get easily and quickly from field to field is of the utmost importance, and has more to do with the cost of plucking than many imagine. Bad and insufficient roads mean time lost in taking up lines for plucking. When it is considered that there are at least thirty rounds of plucking in the year, and the large plucking force is taken into account, the time lost in the course of the year through deficient communications must be considerable. There should always be a road, or at least a path, along the boundary of a field where coolies take up their lines for plucking. Sometimes a path cut, costing a few rupees, will be the means

of saving much time. As an instance of what is meant, a certain estate, which may be said to be typical of many others, had a steep and rocky field with a ravine running down through it; this ravine was too steep and rocky to be crossed except some distance down. When the pluckers had finished plucking the Tea on one side of the ravine, they had to go down to the crossing and up the other side, over which they contrived, as coolies usually do, to waste much time. A little path cut through the jungle above the ravine enabled the pluckers to "nip" through in a few minutes, from one part of the field to the other. In the same way little paths and short cuts here and there cost very little to make and often effect much saving of time and therefore labour.

It is also of the greatest importance to keep roads and paths in first-rate order, not only does it save time to the Superintendent and coolies in getting about, but it is actually cheaper in the long-run to keep roads in good order than in a neglected state. In heavy rains the damage is reduced to the minimum if the roads are in good order, otherwise a road is often converted into a watercourse, the drain gets choked, and the water runs down into the Tea and all over the place, washing away soil and manure.

Repairs to roads is not a heavy item in an estate expenditure, a saving of Rs. 100 in one year might quite well mean the necessity for spending Rs. 300 the following year, and yet it often appears as if men grudged expenditure on roads.

The road should be made or repaired in such a way that the water will run off it quickly into the side drain, and into the Tea. The middle of the road should be the highest part, that is, there should be what is called a good camber. Roads done in this way last longer without need for repairs. Coarse river sand is a splendid covering for roads, it does not wash off like earth or fine sand, earth should never be used for repairing roads if sand can be got handy. So much for roads.

In draining a clearing, if it is desired to open as cheaply as possible, or to get through quickly, I should think drains 50 ft. apart would be good enough to begin with, the intermediate drains could be put in afterwards. Where the trees are so far apart as Rubber is, there should be no difficulty in tracing and cutting the drains clear of the Rubber trees.

But before tracing and cutting the drains, a very necessary thing is to open out all the natural drains, heaping logs and stones on the sides, and leaving a good wide channel for the rush of water from heavy rains. This is a work that is often neglected, but it is of the greatest importance, for not only does it save the soil at the sides of these natural drains or ravines from being washed away by floods, but the logs and stones, acting like terracing, catch any soil being washed down the slope. These natural drains should be made wide but not too deep, they deepen themselves. They should be made the most of, they are what nature provides for draining the land. When they are not attended to they get choked up with stones and debris, and when heavy rains fall, the flood waters wash all over the Tea, carrying away soil, and exposing the roots. This work is of special importance with estates situated, as many are, under high hills covered with jungle, the drainage from which has to find its way through the estates, and in heavy rains often plays havoc with the roads and drains. I have seen damage done in an hour that took weeks to repair, and of course where soil is washed away the loss is irreparable.

When the natural or leading drains have been opened out thoroughly, begin tracing from the bottom of the slope it is proposed to drain, and the best way is to go to the brow of the slope, tracing the drains from the brow down on each side to the natural drain. When the land is very broken, it is difficult always to run drains parallel, the most important thing to bear in mind is to run the drains in such a way that they will cross, as nearly as possible, at right angles to the flow of water down the slope. Tracing drains is work that is rather trying to the temper, especially if the unfortunate cooly who holds the sight stick has only a hazy notion of what is wanted from him, and when, after a long and painstaking trace, one comes bang up against an obstacle in the shape of a boulder or tree stump, one is apt to explode. To avoid an obstacle the better plan is to go to it, and begin tracing from it in such a way that your drain will pass above or below it. Drains should, if possible, be made to run in the same direction as the roads, so that they do not cross, or empty into the road.

As a rule it is a mistake to cut leading drains, they should be avoided if possible. The rush of water eats into the land and makes chasms, the sides of which often fall in wtih the Tea bushes,

The natural drains have usually a bed of stones, a wise provision of nature, which prevents their being worn too deep by the rush of water. Sometimes, though not often, a leading drain cannot be avoided where two sides of a slope converge into a depression, where there is no natural drain.

It is very satisfactory to the Planter to go out in the heavy rain and watch his system of drains working well and preventing the wash that would otherwise take place in his land.

What about fields that are so full of rocks and boulders that it is quite impossible to trace drains in them? There are lots of such land in Ceylon, and it is often the best. I had to deal with much land of this nature; my first thoughts were it is much too rocky to be drained, I had better let it alone, the rocks and boulders will keep the soil together; and so they do, but you will find soil being washed away in places, and you ought to try and save it, if possible, it is worth saving. I found the best way to drain these rocky places is to find the natural drain, that is, the course of the flow of water down the slope, cut a drain up it, or remove the stones that can be removed, then put in a short drain here and there at right angles, just where you can get one, ignoring trace, so long as it carries the water into the natural drain. Your drains then form a herring-bone pattern. Such draining may be incomplete, but it is the best you can do, and is far better than having no drains at all. Of course there may be so many rocks and boulders about that any draining at all is impossible, in such land drains are not necessary, but where you have the rain running over the surface of the land, stop it if you can and save your soil.

Draining serves three good purposes, it carries away the excessive moisture, it prevents soil being carried away, the earth taken out of it forms a valuable top-dressing, it is mostly sub-soil, but it improves with exposure to the air. It is noticeable that wherever there has been a cutting for a road or drain, and the earth has been thrown down among the Tea, how much the Tea improves by the application of a surface dressing, even of sub-soil. You can hardly have too many drains on your estate.

In addition to the regular draining of an estate, some extra draining is nearly always necessary, in patches of sour soil where the tea seems backward. If these patches are examined in wet weather, they will probably be found water-logged, the excess of moisture makes the soil sour. Good deep drains should be cut right through the middle of them, and, if necessary, others at right angles. It always pays to drain and plant swamps, the accumulation of deposit from the wash from the slopes above grows fine Tea. It is a mistake to have a swampy ravine breaking the lines of the Tea, as it hinders pluckers and gives them an excuse for dawdling, an art in which the cooly excels, in crossing the swamp to continue their lines. In a swampy place where there is slab rock and no depth of soil, carry the soil and top-dress the nearest Tea with it, there should be no unused uncultivated soil on a good estate. People are apt to say of such a work, it costs a lot and does not pay, they forget the returns are perennial, though you may not get your money back in one year you probably will in ten, plus improved bushes.

CLEANING OUT DRAINS.

In cleaning out drains the usual method is to throw the soil below the drain, the result is there is an accumulation of soil below the drain, and the Tea immediately above the drain is denuded of soil, and for that reason is usually poor Tea. In such places it is better to put the soil taken out of drains and silt-pits above the drains, terracing with stone to prevent it being washed down again. The hillocky appearance in the Tea (that is, where you see the bushes standing on mounds above the level of the ground), is an indication of bad wash. The best remedy for this, after sufficient draining, is terracing, and filling up the spaces between the terracing with soil from the drains. I have seen "shuck" unprofitable Tea transformed into good Tea by this method, patches which were a blot on the estate made to look as well as the other Tea.

SILT-PITS IN DRAINS.

Many years ago I realised the heavy and serious loss to estates through wash from these heavy plumps of N. E. rains which fall in so short a space of time, that the ground cannot absorb the fall, and the water runs over the surface of the soil, carrying away valuable humus into the nearest ravine, down which it is taken into the river and lost to the estate. Good draining of course to some extent prevents this, but to still further minimize the loss of soil, I adopted a system of silt or catch pits in the drains. These pits were cut 20 feet apart and are about 15 inches deep by 15 inches wide and 4 feet long. They not only catch the soil which would otherwise be washed away and lost, but they keep

the drains from being choked by leaves and sticks. These pits should be periodically cleaned out, and the soil applied as a top-dressing to the Tea near them. Where stones are handy terracing should be done to prevent the loose soil from being washed away again. Various objections have been raised to these pits. One critic says, "What is the good of making them, they get full of soil at once?" Does that not show the necessity for them? Another critic says, "The stuff they accumulate is mostly sand of no manurial value." Sand is of value to the good mechanical condition of the soil, and if you lose the sand you lose a necessary constituent. Sand is of special value in wet districts, and where there is much clay in the soil. The vigorous way in which Tea grows in ravines where there is an accumulation of silt washed down from the hill sides, is proof of what this despised sandy salt is capable of. Try vegetables, grass, flowers, or anything you like in it, you will find they grow luxuriantly. The silt-pits have stood the test of time, and that is the best test. The only real drawback they have is that they are rather apt to breed mosquitoes, but mosquitoes have their seasons, and seem to come and go in spite of anything one can do to get rid of them. They always find lots of places in which to breed, and I have not noticed that estates where there are silt-pits in the drains are any worse in that respect than other estates.

I have given the reader some methods by the adoption of which he can combat the loss to the estate by wash. On a well cultivated estate, where proper precautions are taken against the loss of soil, the humus must slowly but steadily accumulate, and therefore the fertility of the soil and value of the estate must increase. On the other hand, where no particular attention is paid to this important matter (*i.e.*, the loss of soil through wash), the humus disappears, the fertility of the soil diminishes, and it is found that the land requires more and more manure to enable it to keep up its crops.

The following humorous lines appeared in a local paper during a time of very heavy rains and floods:—

"I stood on the bridge at daylight when the
clock was striking the hour,
"And watched my Bamber's mixture agoing
to Baur."

Most planters would enter into the feelings of the author.

THE RELATION OF SCIENCE TO HUMAN LIFE.

(*Continued.*)

The great Frenchman Pasteur, in making a thorough examination of the process by which alcohol was obtained from sugar, discovered the part played by the organism known as yeast, and established the idea of organised ferment bodies. He extended his observation to other micro-organisms, and, in conjunction with his co-workers, among whom must be included those who were looking into the question of the spontaneous generation of living matter, definitely gave us the idea that putrefaction was caused by micro-organisms acting upon organic matter, that these micro-organisms are capable of resisting drought, and when dried float freely in the air and are distributed everywhere. When they fall upon a suitable material their vital activity is resumed, and they increase with incredible rapidity and set up putrefaction. It was reserved for our distinguished countryman Lister, then a surgeon in Edinburgh, to recognise the importance of these discoveries for surgery. Knowing of the researches of Pasteur and his fellow-workers, he conceived the idea that suppuration was due to putrefaction in the organic matter of the wounds caused by micro-organisms. Acting on this, he introduced his method of antiseptic surgery, by which his name has been rendered immortal. I think we may say that no single application of the results of pure research has done more to preserve human life and to diminish human suffering than this linking up by Lister of the putrefaction of suppuration with the work of his predecessors on the effects of the actions of micro-organisms upon organic matter. It is well to notice, in passing, that this discovery of Lord Lister's is a good illustration of the difficulty which the human mind has of conceiving even the simplest new idea. To us, now, how simple seems the step which Lister made; yet there were thousands of surgeons in the world who failed to make it, though they were continually dealing with suppurating wounds and wondering why they suppurated, and when it was made it was stoutly discredited by many quite able men.

I must now turn to another subject which is closely connected with the preceding, and well illustrates my thesis that pure scientific research, without reference to practical utility, is of the highest importance to mankind.

It will doubtless have occurred to many of you to ask the question, How is it, if the air contains floating in it the dried spores of multitudinous micro-organisms which only need a suitable medium for their development and increase, how is it that they do not obtain a lodgement in the healthy animal body, which one would think offers all the conditions necessary to their growth? It can easily be shown that the air we breathe, the water we drink, the food we eat, everything that we touch, swarms with these microscopic creatures; that they enter our lungs, that they germinate in our skin, that they occur in countless numbers in our alimentary canals, in short, that they are found everywhere on our body surfaces. How is it that they do not increase and turn our organs into a seething mass of putrefying corruption? One would expect that even if the skin and the membrane bounding the internal organs to which they obtain entrance incurred the slightest lesion, even a pin-prick, that they would have been able to enter. We know that after death they at once obtain complete dominion, and we therefore infer that in life there must be some protective mechanism in the body capable of dealing with them.

The discovery that there is such a mechanism was made in the early eighties by the distinguished Russian zoologist, Elias Metschnikoff, though the need of its existence was not recognised by biologists in general until later. The result of this was that his remarkable discoveries were at first pooh-poohed and discredited by many, but ultimately they gained acceptance, and their further development in his own hand and that of others has wrought a revolution in the art of preventive medicine.

The mechanism consists of the small amœboid cells found in the blood, lymph, and body fluids generally, and called leucocytes, or white blood corpuscles. Though long known to exist, very little has been ascertained as to their function until Metschnikoff, working at such remote subjects as the embyrology of sponges, the structure and digestion of polyps, the blood of water-fleas, realised that these small amœba-like cells, which exist in all organisms, actually swallow, digest, and so destroy small foreign bodies which have invaded the organisms. He called them the phagocytes, and all his subsequent work has been directed to the elucidation of their mode of action.

It is to Metschnikoff's work, prompted solely by the scientific spirit, that we owe our knowledge of phagocytosis and the great theory of immunity which has proceeded from it. It is impossible at the present moment to estimate fully the value to man of Metschnikoff's discoveries. Suffice it to say that they have already led to import practical results, and have revolutionised treatment.

I must now turn for a moment to another subject of the greatest importance to mankind, and one which has been brought into notice by the researches, perfectly useless so far as our material welfare is concerned, which were undertaken with the view of elucidating the great question of organic evolution. I refer to the study of genetics, which deals with the question mainly of the transmission of the properties of the organism; but it deals with even a larger subject than that. It looks into and tries to determine the laws which govern the origin of the characters of individuals, whether plants or animals, whether those characters have been acquired by inheritance or in some other way. The subject is of the utmost interest and practical importance to man from three points of view. It has a bearing on philosophy of a most important and far-reaching kind through the theory of organic evolution. That theory largely depends for its proof upon the science of genetics. Secondly, it has a most important bearing upon practical questions affecting breeders of animals and raisers of plants, and also upon man himself in connection with practical legislation. This brings me to the third point, in which this subject specially appeals to us, and that is what I may call its bearing upon ethics. This is, of course, closely connected with the last.

We are contstantly confronted with questions in which we have to think, not only of the advantage and happiness of those alive at the present moment, but also of those not yet born who will succeed us on the earth. The decision of these questions is one of the most important and burning subjects which can be put before us. They often crop up in legislation, and yet we are quite unable to answer them because of the very little knowledge we possess of the laws which govern the transmission of characters from generation to generation.

The interests of future generations often appear to be in conflict with the immediate pleasure and happiness of the living, and we are confronted with the question whether we ought to give way to our own humane and benevolent feelings, or whether we ought to set

our teeth and deal ruthlessly with a number of people who must appeal to our pity, lest by saving them from elimination we should bring about an increase in the number of people who are unable to hold their own, and so weaken the nation and increase for the next generation the difficulties which we set out to cure. I do not pronounce any judgment on these questions; I merely wish to emphasise the immense, the transcendent importance from the human point of view, of the investigations which the study of the question of evolution has caused biologists to carry out into that most difficult of all subjects, heredity, and of obtaining clear ideas upon the subject. These, I admit, are elementary examples, and probably familiar to most of you—and they might be largely added to form other branches of zoology, such as entomology, marine fauna, and physiology—of the great practical achievements which have followed from the recognition of the fact possibly appreciated in some ancient civilisations, but in modern times first understood by Bacon and his compeers, that natural phenomena are in themselves, and without reference to immediate utility, proper subjects of man's inquiry, and that all progress must be based on their thorough and accurate investigation.

The genesis of a new idea is so difficult, and the amount of work necessary for its complete elucidation and development so vast and detailed, that many eminent men, taking only a short period of time and not realising the minute steps by which the advance of knowledge takes place, have been led to doubt the value of scientific investigation in the higher realms of pure knowledge, even to the extent of speaking of the bankruptcy of science. Others, again, perceiving the apparent aimlessness of many investigations and undervaluing the motive which urges them on, have come to look with a certain contempt upon the man of pure science and his slow and plodding progress. What is the good of all this work at unimportant details? What do you get out of it, and what pleasure do you find in it? they ask, and when they are told that the humble worker usually gets nothing out of its work except the pleasure of doing it, and that his motive is nothing more elevated than the satisfaction of his curiosity, there does appear to be, it must be admitted, some justification for the contemptuous indifference with which the poor researcher is regarded by a considerable section of the population, as is shown by the almost entire absence of support of pure scientific research on the part of the Government. With the exception of an annual grant of £4,000 a year given to the Royal Society, I think I am correct in stating that the Government affords hardly any support to science save to such as is concerned with teaching or with some practical problem; and when one remembers the composition of Governments and the manner in which, and the reasons for which, they are chosen, one cannot unreservedly blame them for this attitude. The best method of fostering research is a difficult problem, and I can well understand that a modern democratic Government, depending as it does upon popular support with its attendant popular mandates, should shrink from dealing with it. To do so would bring them no popularity and no votes, and too often they are not really aware of its immense importance to human progress, and when they are they have great difficulties to face.

For it is impossible to organise research on a commercial basis. "All attempts," says Prof. Nichols, of Cornel, "at a machine-made science are doomed to failure. No autocratic organisation is favourable to the development of the Scientific Spirit. No institution after the commercial models of to-day is likely to be generously fertile. You can contract for a bridge according to specifications. No one, however, can draw up specifications for a scientific discovery. No one can contract to deliver it on a specific day for a specified price, and no employee can be hired to produce it for wages received."

This it is impossible to get the public to understand even when it has undergone the process which we call education. You may establish paid posts for scientific research, but you cannot be sure that you will get research, for science is like the wind that bloweth where it listeth, and that is what our educated public do not like. They want something for their cash, and they will not wait.

Even those who are aware of the immense value of pure research forget the fact that the aptitude for scientific investigation is as rare as the gift of poetry, to which in many respects it is allied, for both are creative gifts, rare and precious. They forget that it is impossible to ascertain without trial whether a man possesses it or not, and that this trial can only be made when he has passed his student days and looks to support himself by his own exertions. To provide for this support money is needed, and studentships must be estab-

lished in considerable numbers, from the holders of which those who show that they possess the gift of research can be selected and promoted to higher posts in which their gift can find full opportunity; but we want more than this, we want compensation for those whom we have encouraged to make the trial and who have failed to show that they possess the gift, and an outlet by which they can emerge and find work in practical life.

This has been and is a difficulty in all schools of science, for many are called but few are chosen. The situation is this: it is desirable that a large body of able young men should be encouraged to take up scientific research, but as experience has shown that only a small proportion of them will possess the qualities by which success in research can be attained, and as it is undesirable to encumber the progress and the literature of science by a host of workers who have no real capacity for research, it results that a time will arrive when a great proportion of those whom we have encouraged to give some of the best years of their life to this unremunerative work should be invited to find other occupations. What is to be done? We cannot throw them into the street. Some compensation must be given. There are two ways in which this can be done. One is the system of prize fellowships, which has for long been in vogue at the old universities, and which it has of late been the custom of those who have not really studied the matter to decry. Nevertheless, it is a good system, for it provides an income by which those who have given some of the best years of their life to this trial of their capacity can support themselves while they qualify for taking part in a practical profession.

A prize fellowship system, or something like it, is a necessary accompaniment of a university which induces a large number of young men to follow for a time the intellectual life; it acts both as an inducement and a compensation, and it would be a mistake and an injustice, in my opinion, to abolish it; but there is another way in which the difficulty can be met, and that is the way which has been adopted by the wise and far-seeing founders of the Imperial College, namely, by the combination of a school of science with a school of technology. If you have incorporated in your school of science a school of applied science, and if you at the same time take care that none but able men are allowed to enter the research grade, and if you establish, as you must do if you honestly work your school, a connection with the great industrial interest of the country, you have all that is necessary for the disposal of those men who, for whatever reason, find themselves unable to follow a life of pure science. As is well known, the faculty for pure, apparently useless, research in science is often possessed by men without any aptitude for practical application of science or desire of practical success and the wealth which practical success brings; while, on the contrary, many minds of the highest order cannot work at all without the stimulus of the thought of the practical outcome of their labour.

In our College there is room both for those with the highest gifts for pure scientific research and for those with the inventive faculty so important in the arts, or with the knowledge and ability for controlling and organising great industrial enterprises; and, what is more, the combination of the two types of mind in the same school cannot but be of the greatest advantage to both, not only on account of the atmosphere which will be created, so favourable to intellectual effort, but also because good must result from the contact in one school of minds whose ultimate aim is to probe the mysteries of nature and to acquire control over her forces.

As Prof. Nichols has well said in pointing out the dependence of technology on science:—"The History of Technology shows that the essential condition under which useful applications are likely to originate is Scientific productiveness. A country that has many investigators will have many inventors also . . . Where science is, there will its by-product technology be also. Communities having the most thorough fundamental knowledge of pure science will show the greatest output of really practical inventions. Peoples who get their knowledge at second hand must be content to follow. Where sound scientific conceptions are the common property of a nation, the wasteful efforts of the half-informed will be least prevalent." These are sound conclusions, and experience has shown that if the terms are interchanged the same remarks may be made with equal truth of the good influence which results to a school of science from its association with a school of technology.

Before concluding, it may be well to say a word as to the origin of the great imperial institution in the interests of which we are met here to-day. It may justly be described as the natural and necessary outcome of the scheme for

scientific instruction which was originated by that great Prince whose memorial stands near the end of Exhibition Road, and to whom science and art in England owe so much.

He dreamed a dream which his untimely death alone prevented him from realising. Had he lived, who can set a bound to what he would have achieved for science and education in England? It is a most happy circumstance that the final stages of the realisation of that dream should have been entered upon in the reign, and have received the sympathy, patronage, and active support of his great son, our most gracious King, who is working in so many directions for the welfare and happiness of our race.

There is one further point I must touch upon. In the few remarks which I have had the honour to make to you, I have endeavoured, however imperfectly, to embody in words certain thoughts which bear upon a great subject. I thank you for the patience with which you have heard me. Whether I have produced the effect I desire I know not, but I know this, that even if I had the tongues of men and angels, no words of mine could have been so apt, so expressive as the magnificent deed of Mr. Otto Beit recorded in to-day's newspapers. It is impossible for me to pass this over in silence, so closely is it connected with the subject of my address. There are two ways of manifesting thought, by word and by action. Mr. Beit has chosen the latter and far more effective way. We can only express our respectful admiration and gratitude for his generosity, and our thankfulness that a man should exist among us with the power, the insight, and the true humanity to do such a splendid deed.

MINUTES OF A MEETING OF THE COMMITTEE OF AGRICUTURAL EXPERIMENTS :

HELD AT THE EXPERIMENT STATION, PERADENIYA, ON 13TH JANUARY, 1910.

The following members were present:—Mr. R. H. Lock (Chairman), the Entomologist, the Mycologist, the Agricultural Chemist, The Hon. Mr. Edgar Turner, Messrs. Jowitt, Anderson, Vanderstraaten, and the Secretary, J. A. Holmes.

Mr. Bamber read the Progress Report of the Experiment Station since the previous meeting, and the following resolutions were passed:—

1. That a Circular on Tea be published at the earliest possible date.

2. That a separate file be kept for each plot, and that the outlay on and returns of each plot be recorded in its file.

3. That Mr. Jowitt's monthly report form be adopted with such modifications as Mr. Bamber and the Secretary shall deem necessary.

4. That the scheme for the manuring of coconuts drawn up by Messrs. Bamber and Vanderstraaten shall be circulated among the members of the Committee for suggestions.

5. That No. 13 plot at present under cacao be cut out and the land used for experiments on fruit.

PROGRESS REPORT ON EXPERIMENT STATION SINCE PREVIOUS MEETING HELD ON 11TH NOVEMBER, 1909.

Read at the Meeting of the Committee of Agricultural Experiments held on January 13th, 1910.

Varieties of coconuts have been obtained from Mr. L. W. A. de Soysa and have been put to germinate.

The three nuts from the Penang Show have all germinated. The old coconut plots have been cleared again and experiments will now be commenced.

The copra manufactured from 1,000 nuts mentioned in a previous report was pressed in the chekku mill and a good clear oil obtained.

367·5 lbs. dry copra gave 175 lbs. of oil and 108¾ lbs. Poonac.

MANIHOTS.—Ceara and Dichotoma tapping experiments have been continued and the yields from individual trees recorded. The yield from the *M. dichotoma* (2 years old) is poor. Thinning out the branches to prevent wind damage may have had some effect on this point. Many of the *M. dichotoma* trees have been broken down by the wind, especially in the 12′ × 12′ plot 13 months old.

Those planted 6′ × 6′ now 12 months old have not suffered from the wind, the top growth being more upright, thus reducing the leverage and the area exposed.

The stumps planted 8′ × 8′ have been supplied and are coming on well.

Seed from the 10 months old trees germinated more rapidly and well than from the 2-year old trees.

The *Heptaphylla* seeds have not germinated.

The worst yielding trees on the Ceara plot it is proposed to cut out at once, and seed and cuttings to be taken from the best trees only for propagation and the formation of one or more new plots of this product.

The best results appear to be from a modified spiral tapping and pricking, the healing of the bark being good and rapid.

CASTILLOA.—Tapping has been continued on various lines, and the yield of individual trees recorded. Full spiral apparently give the best results.

TEA.—All plots have now been brought into bearing again and the total yields for the year ascertained and reduced to the standard of 2,722 bushes per acre. The results, given in a separate table, are very satisfactory and point to the great advantage of green manuring especially with dadaps at this elevation.

The dadaps and albizzias on plots 149 and 150 have been cut and mulched. Plots 151-154 have been supplied with Para, which is now established.

The poor steep slopes of these latter plots have been forked down alternate lines and mulched with waste lemon grass.

CACAO.—The yields for the year from all the manured plots have been obtained and a new census of trees taken to reduce them to a basis of 300 trees per acre.

A bad attack of Helopeltis occurred generally throughout the estate, especially where shade was least. Caracas and Nicaragua trees were most affected, and one Puerto de Cabello tree was killed entirely.

Experimental shading of the Nicaragua trees has been tried, and there is a marked improvement, but the unshaded trees are also better.

Dadap stumps have been planted in the unshaded portion.

FIVE ACRES FORESTERO.—The young cacao has suffered to some extent from wind and leaf-eating insects, which have been difficult to find. The plants in the Indigofera plot were more or less defoliated after the crop was cut and mulched.

Spraying with Imperial Bar Soap, which was recommended by Mr. Green will be tried, the soap having been ordered.

COCONUTS—These are coming on well in the 10-acre plot, though a few have died or been destroyed. Seed is being germinated for supplying these.

PARA—PLANTED APRIL, 1906, ONE YEAR OLD STUMPS.—All the trees (except in the cacao plots) have been measured, and plot 78, all over 17″ to 18″ are being tapped from the 1st January at the base:—

Row 1 with the basal \/

„ 2 with the cut from the left only \|

„ 3 „ „ „ „ „ right „ /|

The yields so far are poor.

Plot 87 was deeply forked all over as suggested at the last meeting.

The plots have been supplied with large stumps. A few large trees were blown down and were removed or re-erected and supported.

FUNTUMIA.—The trees are beginning to recover from the caterpillar attack, but the smaller branches were killed back for several inches.

PADDY.—The growth of the paddy is excellent, especially after the green manure, and where the artificial mixture was applied it is 5′ high when commencing to form the grain. A small area was attacked by insects and specimens were sent to Mr. Green for identification.

OIL GRASSES.—Distillations were done at intervals, the Lemon grass from the coconut plots is now being distilled.

The still is answering well and gives a pale coloured pure oil. It holds about 400 lbs. of fresh grass and the oil is all off in about 3-4 hours, working at a steam pressure not exceeding 10 lbs. per square inch.

Plots of Java and Ceylon Maha-pengiri and *Cymbopogon flexuosus* have been planted out.

CATCH CROPS.—Two more plots of sunflower have been planted. The gingelly crop (white and black) was practically a failure, most of the plants being diseased, and the seed failed to mature.

FRUIT PLOTS.—The four varieties of plantains are established, and the few vacancies will be supplied as soon as plants can be obtained.

It is suggested that plots 69 to 77 old cacao beyond the Para rubber may be cut out for further fruit plots, a list of which is given separately.

GREEN MANURES.—Several plots have been cut and weighed, and new plots established. *Crotalaria incana* is suffering from a fungus attack, identified by Mr. Petch as "Wilt disease" caused by *Neocosnospora vasinfecta.* Lime and other fungicides are ineffectual, and leguminous crops will not be grown in this plot again for some time.

Crotalaria juncea, Cassia mimusoides and *Tephrosia* plots have been made.

NURSERIES.—The various coffee varieties including *C. robusta* and Liberian have germinated.

WASH PLOTS.—The loss of soil from April, 1909, to December, 1909, has been ascertained and calculated to the loss per acre. An average analysis of 15 samples of this type of soil on the Experiment Station was taken for calculating the amount of plant food in the washed soil.

The results are very instructive and show the excessive denudation that is going on with free soils of this type. A separate statement is appended.

The roads and drains are being put in order as rapidly as labour permits.

VISITORS.—There have been 241 visitors to the Station since the Visitors' Book was started in June, 1909, and the general interest in the work of the Station is steadily increasing.

Several gentlemen from Southern India, Assam, Java and the F.M.S. have paid visits, and most were specially interested in the green manuring experiments, as this form of cultivation is being found successful in all branches of tropical agriculture.

An application has been received for permission to send one or more coolies here for a week to study tapping before commencing work on rubber now coming into bearing. This was agreed to as in a previous case.

STAFF.—On the 1st instant Mr. Holmes assumed charge of the Experiment Station, and Mr. Wilson Smith, who has been studying for some months on the Station, commenced his duties as Assistant Chemist.

PROSPECTUS OF THE AGRICULTURAL RESEARCH INSTITUTE AND COLLEGE, PUSA.

(The Prospectus is subject to such alterations as may from time to time be ordered.)

PREFATORY.

The Agricultural Research Institute and College, Pusa, owes its inception to the generosity of Mr. Henry Phipps who in 1903 placed at the disposal of Lord Curzon, then Viceroy and Governor-General of India, a donation of £20,000 (which he afterwards raised to £30,000) with the request that it might be devoted to some object of public utility in India, preferably in the direction of scientific research. Part of this donation was devoted to the construction of a Pasteur Institute at Coonoor in Southern India, and it was decided that the balance should be utilized in erecting a laboratory of agricultural research which, it was hoped, would form a centre of economic science in connection with that occupation on which the people of India mainly depend. This connection was subsequently enlarged, and the Government of India have now constructed a college and research institute to which a farm of some 1,300 acres is attached for purposes of experimental cultivation and demonstration.

In 1903, when the research station was sanctioned, it was intended to combine it with a college which should give a general agricultural education, and should serve as a model for the few agricultural colleges and schools of very unequal merit which then existed in India. Recently, however, this conception of the functions of the Pusa College has undergone a material change. It is now recognised that the first and most essential condition of any permanent improvement in the agricultural method of this country is the widest possible diffusion of an organised knowledge of scientific and practical agriculture, and at the same time it is desired to make the country as far as possible self-supporting in the matter of development of agricultural training and research. A comprehensive scheme for the promotion of agricultural education throughout India has accordingly been drawn up, as the result of which it is hoped that every important province will soon be provided with a fully equipped college where students will for three years receive practical and scientific education in agriculture. The position which the Pusa College is intended to occupy in relation to this general scheme is that of a higher teaching institution. Its main object is to enable students who have passed with distinction through a course of a provincial college, by means of a post-graduate course in one of the specialised branches of agricultural science, to qualify for the higher branches of agricultural work.

II. THE PUSA ESTATE.

The estate consists of 1,300 acres, of which 400 are arable, 400 are pasture; nearly all the field crops of the plains can be grown there. The farm buildings are up-to-date, and herds of breeding and milch cattle are maintained. There

are complete arrangements for the manufacture of indigo and the curing of tobacco. Poultry breeding is being carried on; there is a large and well-laid-out orchard and botanical garden. Every facility for the practical teaching of agriculture and agricultural subjects has been provided. The students' laboratories are extensive, well lighted and equipped; there is a library for the use of students. The students' hostel is complete, and there is ample accommodation for 70 students. Waini, on the Bengal and North-Western Railway, is the nearest railway station. It is six miles from the college by a good road. There is a telegraph and post office within the estate.

III. CONSTITUTION AND STUDIES.

1. CONTROL.—The College is under the general supervision of the Inspector-General of Agriculture in India, and is under the direct control of the Director of the Research Institute and Principal of the College.

2. STAFF.—The superior staff of the College consists of :—

1. *The Principal.*
2. *The Imperial Agricultural Chemist.*
3. *The Imperial Mycologist.*
4. *The Imperial Entomologist.*
5. *The Imperial Economic Botanist.*
6. *The Imperial Agriculturist.*
7. *The Imperial Agricultural Bacteriologist.*
8. *The Second Imperial Entomologist.*

3. COURSE.—The ordinary College course extends over two years, and the students will be trained in one or other of the following sections of agricultural science, no students being trained in more than one section at a time :—

1. *Agricultural Chemistry.*
2. *Economic Botany.*
3. *Economic Entomology.**
4. *Mycology.*
5. *Agricultural Bacteriology.*†
6. *Agriculture.*

4. SYLLABUS.—In the absence of experience of the class of students likely to be received, it is impossible to lay down a permanent syllabus of the training in each subject. The syllabus that follows is tentative and is subject to the condition that time will not be wasted in taking students over ground that is already familiar to them.

*The Entomological course is for one year only.

†As the appointment of Imperial Agricultural Bacteriologist is now vacant, instruction cannot be provided at present in Agricultural Bacteriology.

I. AGRICULTURAL CHEMISTRY.

(*Two years' course.*)

(i) A course of lectures and laboratory practice of the same type as laid down in the *Standard Curriculum for Provincial Colleges.*

(ii) A course or courses of lectures in advanced chemistry which shall follow such lines as have an important bearing on agricultural science. Each student will then take up a particular line of investigation suggested to him by the lecturer. At the end of the course each student will write an essay embodying the whole of his work, and the results positive or negative he can deduce therefrom.

II. BOTANY.

(*Two years' course.*)

(*First year.*)

(i) *Physiology of Plants.*—The course will be mainly practical, and will be based on Darwin and Acton's *Physiology of Plants* (Cambridge University Press).

The work will illustrate the effect of various conditions on plant development, and will include :—

(*a*) Respiration.
(*b*) Assimilation.
(*c*) Nutrition.
(*d*) Transpiration.
(*e*) Growth.
(*f*) Movements.

(ii) *The Improvement of Plants.*—The lectures will deal firstly with the principles underlying the modern development of plant-breeding, such as Mendel's Law and Mutation, and secondly with the particular methods adapted to Indian conditions, and this part of the course will be supplemented by field work.

The subjects treated will be :—

(*a*) Evolution, Variation and Mutation.
(*b*) Selection.
(*c*) Hybridization.

(iii) *The Principles of Indian Fruit Growing.*—The course will include—

(*a*) The general management of a modern fruit garden.

(*b*) Special processes, such as Propagation, Pruning and Root-pruning, Weathering.

(*c*) Disposal of the produce.

In the case of students who show special aptitude for work in Economic Botany, and who are likely to become qualified to undertake original work, the course will be extended to two years.

(*Second Year.*)

In general this second year's work will deal with the practical application of the principles of plant improvement, and a general knowledge will be given to students of the planting, cultivation and improvement of plants which are of special economic importance in their respective provinces.

III. ENTOMOLOGY.

(*One Year's Course.*)

(i) Collecting, pinning, setting.

(ii) Classification. How to use text-books.

Classification. How to use the collection.

(iii) Anatomy of cockroach or other form.

Comparative anatomy as shown by dissection, mouth parts, etc.

Terms used in classifying.

(iv) Classification and terms used in each order.

(v) Actual identification and revision of the collection.

(vi) Biology and life histories—general, special and details.

(vii) An account of each family in order.

(viii) Pests:—first general, then special by order, then special by crops.

(ix) Complete list of the injurious insects in India.

(x) Preparation of leaflets and lecture course for the province, with exhibition collection of insects of that province.

(xi) Useful insects (lac, silk, apiculture).

(xii) Beneficial insects and birds.

(xiii) Preventive and remedial measures.

IV. MYCOLOGY.

(*Two Years' Course.*)

1. *A Revisionary Course in Plant Anatomy and Physiology.*—Time—two to three months.

Anatomy, Histology of the cell and tissues. Anatomy of the root, stem, and leaf.

Physiology of nutrition.

2. *General Mycology.*—Time—six months.

Definition and characters of the fungi.

Structure of the Thallus:—

(*a*) Vegetative portion, mycelium, rhizomorpha, sclerotia.

(*b*) Reproductive portion; sporophores; spores; germination.

Life habits of fungi.

Dissemination.

Polymorphism.

Food of fungi, saprophytes, parasites.

Symbiosis.

Heteroecism.

Specialisation of parasitism.

Classification. The study of the six main groups of fungi with examination of types.

3. *Pathological Mycology.*—Time—15 months.

Causation of disease by fungi. Infection.

Effects of parastic fungi on plants.

Diagnosis of disease: symptoms of fungus attack.

Prevention and treatment of fungus diseases of plants.

Predisposition of plants to disease: immunity.

Factors of disease. Epidemics.

A general study in field and laboratory of the principal fungus diseases of crops in India.

A more detailed study with experiments of a selected fungus disease.

If possible, the student should accompany a trained assistant in a field enquiry for the purpose of giving him practice in independent observation and collecting information.

V.—BACTERIOLOGY.*

A short course in bacteriological methods, preparation and sterilization of media and the cultivation of bacteria. Students who have passed through this training satisfactorily will take part in the research work of the laboratory under supervision.

VI.—AGRICULTURE.

Special instruction will be given in the management of field and garden crops and orchards, and in the use of agricultural machinery, tools and implements and in cattle, sheep and poultry breeding.

As a temporary measure to assist the provinces which are not in a position to train their own men as superintendents of farms or for other positions requiring a practical agricultural education, a course in general agriculture will be given.

* As the appointment of Imperial Agricultural Bacteriologist is now vacant, instruction cannot be provided at present in Agricultural Bacteriology.

5 TERMS.—The terms for students are as follows :—

Autumn Term.—From 1st June to 15th November.

Vacation—From 16th November to 5th January.

Spring Term—From 6th January to 31st March.

Vacation—From 1st April to 31st May.

6. CERTIFICATES.—For the present it has been decided not to hold periodical and final examinations, but certificates, signed by the head of the section and countersigned by the Principal, will be presented to students who have passed through the College course with credit.

IV. ADMISSION RULES.

1. *Accommodation.*—The total number of students that can ordinarily be admitted in each of the following sections every year is as follows :—

Agriculture	8
Agricultural Chemistry	8
Mycology	8
Entomology	8
Botany	8
Agricultural Bacteriology ...	4
	44

The number of studentships to be allotted each year to the respective provinces as well as the number of nominations, if any, to be made by the Principal, will be decided by the Principal before the 1st April, after consultation with the provincial authorities as to their requirements, and communicated to the Local Governments and Administrations concerned.

2. *Students.*—There will be three classes of students :—

(i) Students nominated by a local Government or an administration.

(ii) Students deputed by a Native State, on the nomination of the Inspector-General of Agriculture in India.

(iii) Private Students.

3. Students nominated by a local Government or Administration should ordinarily be men who have passed with credit through a provincial agricultural college, or are graduates of an Indian University or possess a degree or diploma of approximately the same standard granted by any other educational institution.

4. Students deputed by a Native State may be admitted on the application of the State concerned, provided that accommodation is available. Applications should be addressed, in the first instance, to the Inspector-General of Agriculture in India, Nagpur, Central Provinces, and should reach him before the 15th March. The nomination of such students is made by the Inspector-General of Agriculture in India, and his nomination should reach the Principal before the 1st April, as provided in Rule 1 above.

5. Students of class (ii) above will be required to pass a satisfactory test to be applied by the chief of the section concerned at Pusa.

6. (i) *Private Students.*—Private students may be admitted by the Principal provided that accommodation is available. Candidates for admission should be not less than 19 years of age, and should submit their applications to the Principal before the 1st April in each year. Ordinarily only candidates will be admitted who have the same qualifications as are prescribed for students nominated by a Local Government or Administration in Rule 3 above, and such candidates may also be required to pass the test mentioned in Rule 5 above.

(ii) A private student must attach to his application (*a*) a certificate of age, (*b*) health certificate signed by a Civil Surgeon testifying to the candidate's physical fitness for such outdoor work as is required to be in the Agricultural Department, (*c*) a certificate of good moral character from the Principal of the Agricultural College from which he graduated or from any one else of influential position. The certificates (*b*) and (*c*) must bear a date within six months of the date of application for admission into the College.

(iii) The principal may relax any of the conditions imposed under rule (ii), should he consider it desirable.

(iv) The names of those private students who succeed in obtaining the College certificates will be entered by the Principal in a register to be kept for the purpose, and will be communicated to the Directors of Agriculture in the various provinces so that these private students may be offered employment if their services are required. The names will also be published in the *Gazette of India* and in provincial Government Gazettes.

7. It will be at the discretion of the Principal, with the advice of the scientific officer in charge of the section, to declare at any time the unfitness of a student for training and to require his removal from the College.

8. The expenses of a student at the College will, it is estimated, not exceed

Rs. 25 per mensem. But the following sums will approximately be required for the purchase of books:—

	Rs.
Agricultural Chemistry	15
Economic Botany	15
Entomology	22
Mycology	25
Agricultural Bacteriology	15
Agriculture	15

9. Local Governments will be left to make students, whom they depute to the College, allowances and grants as they think fit. In the case of students already in Government service the allowance should not exceed the pay of their grade, and in the case of other students they should not exceed Rs. 50 a month.

10. Caution money and initial deposits will not be required from students nominated by Local Governments, except in the case of students required to undergo training at the College at their own expense, who must deposit with the Principal a sum of Rs. 50 to meet the initial cost of books and in addition Rs. 50 as caution money.

V. DISCIPLINARY RULES.

1. The Director and Principal is charged with the general control of the students, the housing and domestic arrangements, and the maintenance of discipline, and he will from time to time issue such rules and regulations as may be necessary to secure these objects. All the correspondence relating to the training of students should be addressed to the Director and Principal, Agricultural Research Institute and College, Pusa, Bengal.

2. (i) *Quarters.*—The Principal will allot to students on arrival such quarters as may be available. The College quarters are tenable during the whole period of the student's course. For the present no rent will be charged for the quarters, but the Government of India reserve the right of withdrawing the concessions from all or any class of students entering the College hereafter.

(ii) Students must make their own arrangements for meals. Separate dining rooms will be provided for different castes and religions, and meals will not be allowed in quarters without the consent of the Principal.

(iii) Every student will be responsible for articles placed in his charge. In case of loss or damage arising from carelessness he may be called upon to pay.

(iv) Students will not be allowed to keep dogs. Horses and cattle cannot be kept without the permission of the Principal.

(v) No student may leave the estate premises without the permission of the Director and Principal. No student may be absent from his quarters after 10 p.m. without the permission of the Director and Principal.

3. *Library.*—The use of the Library will be allowed subject to the Library rules.

4. *Books and Instruments.*—The list of books required by students of each section will be published by the Principal from time to time. Apparatus and other laboratory requirements will be provided free, but students using them will be responsible for their safe custody and return.

5. *Leave.*—During the course of instruction no student may leave Pusa without the order of the Principal. Subsidiary rules regarding leave will be made by the Principal from time to time.

6. *Holidays.*—Such of the usual gazetted holidays as are allowed will be notified from time to time.

7. *Punishments.*—Students are liable to the following punishments which may be imposed by the Principal:—

Entry in conduct register.
Stoppage of leave or fine.

Removal or dimissal from the College.—An extract of the order of this kind passed by the Principal shall be forwarded to the Local Government or Native State concerned for information.

AGRICULTURAL CONDITIONS IN JAVA.

(From the *Philippine Agricultural Review*, Vol. I., No. 10, October, 1909.)

During the months of April and May, 1907, I visited Java for the purpose of studying agricultural conditions in that country. These investigations covered a period of thirty-two days, in the course of which a number of the leading plantations in different parts of the island were visited. The following paper is a brief report of the conditions found on three plantations:—

COFFEE AND CACAO.

Pare is the distributing centre for a group of coffee and cacao estates which extend along the sloping sides of the recently extinct Kluet Volcano. In the palmy days of coffee culture in Java, before the price dropped from P 56 to P 34 per picul, these plantations were prosperous, but the sudden fall in prices reduced the profits to such a degree that the owners were willing to sell very cheap.

One of the plantation managers in this district realising that by proper cultivation the coffee business would still yield a profit, purchased twenty of these defunct coffee estates, and secured an able manager for each one. I visited one of these estates and saw coffee culture from the planting of the seed to the sewing up of the sacks for export. I was told that this plantation was purchased for P 13,000, and that the profits for the first two years equalled the original cost. The estate is now valued at P 160,000. It is apparent that the manager realises that *good* plantation management costs money, but that in the end such management is the cheapest.

He insists that the soil under and between the coffee trees shall not be cultivated, but the weeds are pulled every ten days, and the trees are also trimmed at this time. This pulling of weeds makes it possible to remove them with the least possible disturbance of the soil. The weeds and leaves are left beneath the trees. The reason for this method is to imitate as near as possible the conditions found in the natural forests. The object is to keep the trees hardy and free from disease, and to maintain these conditions the too ready growth is prevented by keeping the soil under the trees packed. On this plantation every operation is thoroughly systematised and every cent put out for labour is for value received. The plantation is divided into several sections, each one of which is managed by a Dutch assistant.

Coffee is gathered in Java during the months of January, February, March, April and May. The same tree is repicked every ten days. Coffee pickers earn comparatively large wages, some as high as 30 cents per day. The same day that the berries are picked they must be hulled, as otherwise a lower grade of coffee is secured. The berries are passed through the pulping machine, which remove the outer soft skin. The hulled berries are then carried by a flume to the fermenting tank. After a day or so they are removed to the drier where they are dried either by the sun or a wood fire. A machine then removes the parchment seed coat, after which the kernels pass through a cylinder which grades the coffee according to size. The round berries are worth the most and are carefully picked out by hand just before the coffee is packed. These berries are said to contain more pith, which is the part of the bean producing the most desirable flavour. The coffee is sacked in the same way as rice.

The plantation I visited contained scattering trees of Liberian coffee. These trees are allowed to grow 18 feet high. The berries are reached by means of a ladder and are picked every week during the year. No more Liberian trees are being planted.

Coffee is planted in raised seed beds that are well shaded. The seeds are planted 6 inches apart, and it requires about 40 days for them to germinate.

Considerable damage is done on the coffee plantations by a squirrel-like animal which eats the coffee berries.

The dadap tree is used to shade the coffee. The trunk of this tree is also used as a support for pepper vines.

When a coffee tree dies it is replaced by another coffee tree, but when a small section of coffee trees die that section is replanted with white cacao. The white cacao trees withstand disease better than the red. Cacao trees are inspected every five days. The pods are ripe when they turn a little yellow. I was told that red ants eat the bark, which is then attacked by a fungus growth which sometimes kills the trees. When one tree is removed its place is not refilled until after one year.

Before planting cacao, a hole 1 meter each way is dug and left open for two months; the hole is then filled and after the rains have packed the soil well, a young plant is inserted. To prevent wild deer from browsing the young trees, each tree is inclosed in bamboo structure. The cacao seeds are first germinated and are then planted in a narrow, loosely woven basket.

The seeds which are prepared for market are allowed to ferment in a box or basket covered with an old coffee sack. The seeds of both the coffee and cacao become quite warm during the fermenting process. After two or three days the seeds are washed in water and are then dried, sacked, and shipped.

CASSAVA.

At Nagadilaoewer I visited a cassava plantation owned and operated by an Armenian. Formerly the volcanic sandy soil found here produced coffee, but owing to the drop in prices previously referred to, the coffee estates were abandoned. The owner of this plantation purchased several of these defunct coffee estates for a small sum. He pulled out all the coffee trees and planted cassava, though at the present time the price of the finished product is not as high as it was formerly.

Volcanic sandy soil seems best suited for cassava, and with such soil, planting and harvesting can be carried on at all seasons of the year.

On this plantation a stick can easily be pushed 3 feet in the soil. At one place where a man was digging a hole, I noticed that the sub-soil at a depth below 4 feet contained considerable gravel. The soil was being ploughed 12 inches deep with light English steel ploughs. Native wooden ploughs with wooden beams and steel points were also being used.

Cassava is planted in rows 4 feet by 3½ feet apart, and is cultivated the same as corn in the United States. The soil contains so much sand that it is very easy to cultivate, and can be tilled during both the dry and rainy seasons.

A red spider and root larvæ seem to be the greatest enemies. To stop planting in the infected regions is the only successful remedy known for this trouble. Para rubber is being introduced and planted in the cassava fields. This, however, is only an experiment.

Cassava is propagated by cuttings from the stem, each of which is about 8 inches long. It takes fourteen months to produce a crop. A new variety of cassava is now being experimented upon which is expected to mature in about nine months, or five months earlier than the original variety.

The roots are pulled and loaded upon large bull carts, weighed near the fields, and hauled to the mills where they are weighed again. On the plantation visited it is intended to put in 20 miles of track in the near future, which will be used both for transportation of the roots to the mill, and of the pulp waste from the mill to the fields, where it will be used as a fertiliser.

In the manufacture of cassava starch the outer skin is first cut off with a bolo. The washed root is then ground fine and run through a sifting machine where the starch is separated from the cellular matter. The milky fluid is conducted through a long trough, from which it is distributed to the settling boxes. In these boxes the starch settles and the water is run off, after which the starch is taken out and dried either in the sun or by wood fires. When thoroughly dried it is reground in a roller mill to a fine flour. It is then sacked and shipped.

The cellulose, containing possibly 5 per cent. of starch, is ground fine and used as one ingredient in a new horse feed.

A cassava mill must always have a good supply of water, and cheap firewood is also necessary, for on damp days the starch must be dried by wood fires.

SUGAR AND TOBACCO.

The sugar estate I visited at Tymol is said to be the largest and most modern one in Java.

The only land owned by this sugar company is the building site for the mill and that occupied by the houses of the Dutch employees. The other land belongs to the Javanese. Each man who belongs to the community owns one or more rice fields. When a company desires to start a sugar plantation in a certain locality it must first get permission from the Dutch Government. Permission must then be secured from the native chief or headman of the immediate district, and finally the land is rented from the individual Javanese. I inquired what was done if the individual landowner refused to rent his land, and was told that a deep ditch was dug around his paddy so that he could get no water for irrigation. It is probable that this labourer and his family would also be refused employment on the sugar estate. These conditions are, however, very rare, as all desire the rent money and an opportunity to work on the estate.

Only one-third of the total area of land in any given community can be planted to sugar at one time, the remaining two-thirds being planted in rice, peanuts, soy beans, sweet potatoes, or corn. In many fields the rice is harvested, the land irrigated to make it soft, and the peanut seeds are dropped into a hole made by a blunt stick, without reploughing the soil. The sugar planter prefers a rice crop to precede sugar, as the soil is then free from weeds.

Sugar cane is grown for seed on a small plantation located in the highlands. This arrangement is very necessary to prevent the stock from deteriorating. Seed from this highland plantation is taken to the lowland estate and planted 3 feet apart in rows in a nursery bed, where it grows from January until May, when planting begins. The young plants are then pulled. The lower ends of the stems are cut with a slanting stroke and search made for a certain disease, the presence of which is sown by many red specks located especially at the joints. If several joints are affected the stock is discarded, but if one joint is slightly affected it is used. This disease causes considerable reduction in the percentage of sugar in the cane.

In the seed bed cane is planted 3 feet apart, but in the field 5 feet apart. The soil is well trenched by hand labour. Long ditches, both for drainage and irrigation, extend in parallel rows from the higher to the lower side of the fields. These ditches are about 25 feet apart and 3 feet deep. During the rainy season the drainage ditches are cleaned after every rain. Rows of sugar cane extend from one drainage ditch to another. Trenches are dug in which the cane is planted. These trenches are about 2 feet deep and 2½ feet wide. The trenches are left open for a month or more, so that the soil is thoroughly ærated, and the weeds are all carefully pulled. A small amount of peanut meal is first scattered in the bottom of the trench and is covered with about a 6-inch layer of loose soil. The sugar cane is planted end to end, and pressed in the soil, the buds being at the side. A little soil is then thrown on top of the cane and sprinkled with water from the trench ditches. An extra joint of cane is planted at the end of each row to replace any that fails to grow. As the shoots appear the trench is carefully filled until it is higher than the ground between the rows. The stem is thus started more than one foot below the surface of the soil. As the shoots multiply the soil is crowded between them. If there is no rain for a day all of these short rows are hand sprinkled. At the time of harvest the soil is dug and each stem is pulled, no cane being left in the field. Harvesting is done by gangs of labourers, each gang being paid according to the amount of work done.

The cane is carried by hand a short distance and placed on cars. Portable tracks are placed wherever harvesting is being done. Two carabaos hitched together with a yoke pull the loaded cars to the mill. The cane is hauled to the mill the same day that it is cut, and it is ground the following night and next day. The harvesting season lasts for about seven months, beginning in May, and during this time the work at the sugar mill is carried on night and day, the men working in eight-hour shifts.

The cane contains a maximum amount of sugar at a certain age and should be harvested at that time. In order that the cane may be maturing as the harvesting progresses, planting continues throughout the harvesting season. Some varieties of cane mature in twelve months, others in fifteen months.

All labour on the plantation, except in the sugar mills, is paid for by the piece. The prices are so arranged that men cannot earn much over 25 cents and women over 12 cents per day. The head boss of each gang receives money daily to pay his men. The men know how much money should be paid for doing a certain piece of work, and how much their portion should be. The labourers are paid each evening; this pay system seems to be very satisfactory.

Since only one-third of the lands adjoining are planted with sugar, two-thirds of the total are left for the Javanese. The plantations rent for the period of twenty-three months, which is just sufficient time to plant and harvest a sugar crop. At other times the Javanese plant such crops as best fit the land for a future crop. On the plantation I visited 24,000 acres are planted annually. A refining machine has recently been added to the equipment of this plantation, and a fair grade of granulated sugar is now produced. During nine months of 1906 Java exported 1,500,000,000 pounds of sugar, and during the same period the exports of sugar from the Philippine Islands were about 150,000,000 pounds.

At Klatten I visited a large sugar and tobacco estate. The manager of this estate is an expert chemist, having studied two years at Columbia University, New York. This estate includes 200,000 acres of land and 60,000 Javanese live on it. On certain fields tobacco was planted, followed by crops of rice. Tobacco and sugar cane were never grown on the same field. A large pumping station was just being installed to supply water for irrigation during the rainy season.

Peanut meal and sodium nitrate are used as fertilisers for the sugar crop.

At the time of my visit, which was about May 2, the sugar was not ready for harvest, and it was too early for planting tobacco.

The people were all gathering rice, after which the soil was broken for tobacco.

Ten Javanese boys are being instructed in the chemistry of sugar. After the ten months' course the more apt ones are to be given employment as sugar testers in the mills.

There are several sugar mills in the estate, the largest one producing 100 tons daily. It requires 36 hours to obtain granulated sugar from the cane.

I asked the manager what he considered the most difficult problem. He replied that the growing of the cane was the only great question. Mills can be erected in a few months, and there is no difficulty in securing plenty of sugar makers.

Rice.

The system of rice culture in Java is about the same as that of the Philippine Islands. Mr. Pitt, who has charge of the Government Economic Garden at Buitenzorg, told me that the native method of culture was the best system when pursued according to the custom of the better class of natives. The application of manure has not been found practicable, as the increased yield did not justify the outlay. After one rice crop is harvested another is immediately planted. The fields are never allowed to remain idle, but are always kept in cultivation. This is in part due to the congested population, but undoubtedly greater yields are obtained than would be the case if the fields were allowed to return to jungle.

The rice is picked one head at a time, and later is sorted so that the stems of the same length are together.

About two-thirds of the soil in Java is tilled by hand labour. The instrument principally used is a long, broad-bladed hoe with a blunt handle. Tools are made and owned by the natives. The sod on the dikes is all removed and worked into the soil for fertiliser.

Kapok.

From the car windows I observed a large kapok plantation and was told that the kapok trees were formerly planted along the irrigation ditches throughout Java, but this custom was stopped, as the native chiefs in each section secured all the kapok.

Cinchona.

The government cinchona plantation is located in the same volcanic basin as the Malabar tea estate. It extends along the sides of the basin for several miles and includes elevations from 3,000 to 5,000 feet. Trees at an elevation of 5,000 feet are healthier than those below or above this point. At this elevation I saw trees forty years old that were possibly 8 inches in diameter and 30 feet tall. Seeds for these trees came from South America, and from these trees seeds were secured in turn for the other cinchona plantations in Java. The sandy, volcanic soil contains plenty of humus and receives 3,000 millimeters of rainfall annually. Seeds from the older trees are used for propagation. They are planted in raised seed beds 4 by 20 feet in size. Each bed is protected from the sun, rain, and wild animals by the construction of a grass, or bamboo shack. In the daytime one side is opened to receive light and air. The young plants are liable to damp off if given too much water. After six months the seedlings are transplanted to long nursery beds which are not protected. Here they remain until they are planted in the field. Plants for new and rich soils are propagated from seed, the plants intended for old and poorer soils are grafted. This is done while the trees are in the long nursery beds.

The grafting is done by the natives and the results are excellent. Both the seed beds and the nursery beds are provided with new soil every two years. The soft, mellow soil containing much more humus is preferable. The plantation I visited is terraced to prevent the washing of the soil.

The trees are transplanted from the nursery beds during the rainy season and are set out 3 by 4 feet apart. Each terrace is about 4 feet wide and slants in a little. A rectangular hole 18 inches deep by 18 inches long and 6 inches wide is dug near each tree. This hole serves as a pocket to hold rain water, it also allows the air to enter the soil and serves as a receptacle in which weeds and grass are deposited. The soil on this terrace is kept thoroughly cultivated; both men and women do this work and are paid according to the amount of land cleared. At each clearing the old holes are filled and new holes are dug.

Harvesting begins in two years and is kept up definitely, replanting being done where the old trees are removed. Trees are not usually allowed to grow for a longer period than five years. Harvesting is done during the dry season.

Harvesting by years.—First year, one lower branch as large as one's thumb is removed; second year, the second branch is removed; third year, every other tree is removed; fourth year, other trees are removed, replanting begins; fifth year, the largest trees are removed, replanting continues.

Very old and poor soils are fertilised with castor-bean cake which is placed in the bottom of the holes around the trees.

When the plants are young a rather small eating insect attacks the lower side of the leaves, causing them to curl and wrinkle. The most successful method of combating this insect is to keep the plant growing so rapidly that several small leaves are formed for every leaf destroyed. After two years the plants are so thrifty that damage from this insect need not be considered. Another pest is a grub which eats the roots of the young plants. These grubs

may be dug out and destroyed. A fungous growth sometimes attacks the stems and roots of the plants. The leaves turn red and eventually fall off. The plants are dug up and burned, the hole being left open, and after a year another tree is set in.

The bark is removed from the stems and roots as large as one's thumb not later than one or two days after harvesting. It is then carried to the drying house, where it is exposed either to the direct heat of the sun or to a wood fire, for which the wood from the cinchona tree is used as fuel. After being dried the bark is pounded to a powder and put in sacks weighing 200 pounds each.

A small chemical factory at Bandoeng extracts the quinine from the crude bark. This factory is the only one in Java and uses about one-tenth of the cinchona bark grown there, the remaining 5,120,000 kilograms of crude bark being exported to Holland.

The manager of the plantation has recommended to the Government that a factory be established on the plantation. The necessity for this is evident when it is considered that for every 100 pounds of bark transported to the factory at Bandoeng more than 90 pounds is waste.

Land for cinchona is cleared in the same way as for abacá and the brush burned. The superintendent has discovered, however, that better results are obtained where the land is not burned over, and recommends that the brush be burned in piles. This leaves a large unburned area containing a great deal of vegetable matter. The logs remain on the newly-cleared plantation and are not burned, but are left on the land to decay and add humus to the soil.

The percentage of quinine in the bark varies from 2 to 15. By selection and hybridising the percentage has been considerably increased. The export of bark from this plantation was in 1897, 300,000 kilograms containing 4 to 5 per cent. of quinine, and in 1907, 1,000,000 kilograms containing 6 to 7 per cent. of quinine. It is expected that the trees recently planted will yield from 12 to 15 per cent. of quinine.

The cinchona tree has few enemies. It is easily grown provided suitable soil conditions, elevations, and rainfall are present. It can be harvested at any time, and a delay in harvesting does not result in an injury to the product. It can be grown economically on either a large or small estate.

Two thousand natives are employed on this estate, the men receiving about 20 cents and the women about 12 cents as a daily wage. The native villages, three in number, are models of cleanliness and neatness. The manager is a thorough believer in the value of a check plot experiment system.

Domestic Animals.

A large number of ducks are raised in Java. The ponies, cattle, carabaos, sheep, and goats look about the same as those in the Philippine Islands, but are more plentiful. In Central Java the cattle and carabaos are worth, respectively, P16 and P40 each. I travelled twenty days before I saw a pig. This is evidently due to the fact that the natives are all Mohammedans and do not eat pork.

THE PROGRESS OF INDIAN AGRICULTURE.

(From the *Indian Agriculturist*, Vol. XXXV., No. 1. Calcutta, Saturday, January 1, 1910.)

Some amount of impatience is at times expressed because of the apparent tardiness of the various agricultural departments in producing practical results. The impetuous critic is apt to expect that, so much expenditure having been devoted to the improvement of agriculture in this country, great and striking achievements should immediately follow. Indian cotton should be so much improved in quality that it should become the first favourite at Liverpool and Manchester. The cultivation of the Indian sugar-cane and the manufacture of sugar should be brought to such a pitch of perfection as to render the competition of Java futile. Indigo should be placed in a position to oust its synthetic rival. Flax should become a profitable Indian crop, and Indian cigars should be smoked in preference to Havanas. Above all, the Indian ryot should advance at one stride to the status of a scientific cultivator. This is the kind of progress which would appear to be required to satisfy many of those who look upon the establishment of Agricultural Departments in this country as a disappointing experiment. We do not doubt that the majority of these results will be attained in due time. It is impossible to read the extremely interesting Report which the Inspector-General of Agriculture has prepared upon the Progress of Agriculture in India in 1907-09 without taking

sanguine view of the prospects of this country as a producer of the materials of manufacture. But it is equally certain that the development of its resources will be a slow process, and that it is unreasonable to expect immediate results from Departments which are as yet in their infancy. In the first place, the officers of these Departments must themselves go through a more or less lengthy process of study before they can undertake to teach those who are pursuing agriculture according to the methods which embody the experience and traditions of centuries. The possibilities of improvement can only be realised by those who have familiarised themselves with existing conditions. This may seem a truism, but in reality it is a truth which was discovered as the result of costly and humiliating failures. Further, when improvements suggest themselves their practical value must be tested by a series of experiments. A case in point is that of the hybridisation of cotton. Experiments, says Mr. Mollison, "have brought to light some new ideas which, however, requires confirmation. The crosses at the Surat farm have been found to be undergoing considerable variation. Although their lints have a relative advantage in quality over the ordinary Surat cotton, the ginning percentage is steadily falling (the percentage has fallen from 36·9 to 30·3 during the last five years)." Here is an instance of an apparently successful improvement. The lints of the Surat hybrids have been valued at from 5 to 10 per cent. above fine Broach. Yet, if the hybrids had been officially recommended for adoption without adequate trial, it is easy to see that the effect would have been to discredit scientific agriculture in the minds of the cultivators concerned for some time to come. Nor is this the only example of the necessity of patient observation which the cotton-growing industry supplies. There was good reason to expect that Egyptian cotton would flourish in Sind, but, says Mr. Mollison, "it is disappointing to have to record a set-back in the expectations previously formed," and the conclusion now arrived at is that "unless cultivation is improved and sufficient flow irrigation is obtained as early as March-April there is no likelihood of Egyptian cotton being established as a general field crop in Sind." No one could have foreseen this failure, which has been due mainly to the disinclination of the ryots to carry out the rules necessary for success. Even for assured negative results time is required. It was only after years of observation that the Imperial Department of Agriculture were able to state that, in spite of the enthusiastic claims put forward on behalf of tree cottons, their place as a field crop is "very limited." But, though progress is necessarily slow, benefits to agriculture are already accruing from the great variety of scientific research. The causes of destructive blights have been discovered, and in some instances an effectual remedy has been provided. Thus, the campaign against the palm disease "has been particularly successful and is still being prosecuted earnestly by means of special staff sanctioned by the Madras Government." Mr. Mollison adds:—"I must note the fact that the results of this enquiry by Dr. Butler are so valuable to India that they are equivalent to saving the cost of his section to India for many years to come." We should be disposed to say that Mr. Lefroy's book on "Indian Insect Pests" is almost enough in itself to justify the existence of his section, for, when the information which this work contains is brought home to the ryot, it will effect the saving of many lakhs of rupees. The creative departments have been as fruitful as those engaged in saving the crops from injury or destruction. It may fairly be said that there is scarcely a district in which the possibility of growing a new crop has not been examined or tested by experiment. The list of promising ventures would run to a great length, ranging as they do from cattle-breeding to poultry-farming and bee-keeping, and from the remarkable efforts to resuscitate the indigo industry to the improvement of the sugar cane and of tobacco.

GREEN DRESSINGS AND THEIR APPLICATION.

The Effect on the Buried Plants.

(From the *Agricultural News*, Vol. VIII., No. 189, July 4, 1909.)

The practice of the application of green dressings to soils is one which has existed from the earliest times; in fact, the first records of any rules which have been made for the regulation of agricultural operations show unmistakably that the value of burying green plants in the soil for the benefit of future crops was fully recognised many centuries ago. That this conclusion, reached empirically though it was, is not at fault, has been proved again and again by the most rigid methods of modern scientific investigation. Thus a feeling of security in the following of the practice has

resulted and, in many cases, where no account has been taken of local conditions, actual serious harm has accrued from it. Like all other agricultural operations, that of the application of green dressings is one which is governed by complex, rather than simple, considerations.

It is evident that the results of such a method of manuring, as far as subsequent crops are concerned, depend on two factors: (1) the effect on the buried plants, (2) the effect on the soil. As a matter of convenience, the subject will be dealt with in relation to these two factors. It is not within the scope of an article like the present one to give illustrative examples, so that reference is made to the chapter on Green Manuring in Professor J. G. Lipman's* *Bacteria in Relation to Country Life*, pp. 237-63, where a very complete account of the practice may be found.

That the plants used in green dressings must undergo great changes before they can be of any use to the crops which they are intended to benefit is a matter of common knowledge. These changes take place through the action of bacteria, and, owing to adverse conditions, they may be delayed, or even affected in such a way as to render the action of the manure positively harmful. This is the case in light, as well as in heavy, soils. In the first instance, the fact that such soils are liable to quick drying may, in the event of this taking place, so interfere with the normal bacterial action as to cause the buried material, when the soil becomes wet again, to lose its most valuable constituent—nitrogen—instead of undergoing those changes which would render that element more available. In the second case, an excessive rainfall, or insufficient drainage, will induce a formation of acid substances which will act as a preservative against that decay upon which the material absolutely depends for its effectiveness.

For reasons which are closely connected with what has just been stated, green dressings should never be buried deeply. The depth of cover may be greater in light soils than in those which are heavy. The same considerations govern the procedure when it is a question of applying the dressing when fresh, or after it has been dried. A soil with a large water-holding capacity is more likely to induce beneficial changes in the dried, than in the green material, while, on the other hand, a light, well-drained, sandy soil will show the opposite tendency. Nevertheless, with some crops and under the best conditions, fresh green dressings and dry green dressings show an equal efficiency as providers of nitrogen.

Setting aside other considerations, as far as the crop which is intended to provide the green dressing is concerned, the best time to apply the latter is when it just reaches maturity; that is to say, at fruting time, when about half of the leaves have turned yellow, for at this period the plant has reached the limit of production for that season. An additional reason for not allowing the manuring crop to stand too long is that the water-content of the soil may be reduced to such an extent as to decrease the number of beneficial bacteria to a degree which will inhibit its proper action when it is eventually ploughed in.

Such a consideration, however, namely that of the age which the manurial dressing should reach before it is applied to the land, is governed by another important factor. In soils in the tropics, where bacterial action takes place very quickly, there is a danger that the food which has been rendered available to plants and which, consequently, has become all the more soluble, may be largely washed out of the soil before the crop which is intended to benefit by it has reached the stage when it is capable of taking it in. Thus it is unmistakably indicated that, under the climatic conditions of the West Indies, land which has been treated with green dressings must be put to use soon after their application, in order that loss due to wasteage may be avoided as far as possible.

Dependence is often placed merely upon one or two kinds of plants for the provision of green dressings. This should not be so, especially where there are facilities for raising, and experimenting with, a number of different sorts. The diseases and pests to which various plants are liable have very distinct limitations in respect to each kind of plant, and it is reasonable to conclude that several different kinds of plants, raised on a given area, are likely to give a much better yield than one or two varieties. In the matter of leguminous plants, the consideration is further advanced. A reference to the article on 'Soil Inoculation' in the *Agricultural News*, Vol. VIII, No. 184, of May 15, 1909, will make it plain that different leguminous plants require different varieties of bacteria for the purpose of nitrogen-fixation, and that, therefore, the raising of as many kinds of those plants as is possible in a given

* The Macmillan Company, New York, 1908.

area of soil will result in the largest employment of the bacteria which are present for that purpose.

It requires little consideration to reach the conclusion that, as buried plants are dependent upon the action of certain bacteria for the production of useful plant food from them, any means of increasing the number of those bacteria in the soil will make the efficiency of such buried plants all the greater. This theoretical consideration receives practical support from experiments which plainly show that the admixture of pen manure with the dressings before ploughing in, even in proportions too small for the manure to have any action, of itself, in increasing the yield, has hastened and directed the decay of the green crop in such a way as to cause the maximum benefit to be derived by the one which succeeded it.

The action of bacteria, then, is the chief determining factor in the changes, eventually beneficial or otherwise, which are undergone by green dressings. That this action is of paramount importance in the matter under review will be rendered all the more evident in the next article which, as has been stated, will deal with the effect of the buried plants on the soil.

PROGRESS OF GREEN MANURING FOR WET LANDS.

By H. C. SAMPSON,
Deputy Director of Agriculture,
Southern Division.

(From the *Madras Agricultural Calendar*, March, 1910.)

A short note was written on this subject in the 1908 Calendar, and the matter was again referred to in the 1909 Calendar. It is so important, however, that another article on the same subject will not come amiss.

At first sight the fact that a crop is grown on the wet land and ploughed in, may, to any one who has not tried it, seem a waste of time and money, because nothing except a seed sown is put into the land. In reality this is not so, all the green manure crops referred to below belong to the family of plants which have the power of collecting nitrogen from the air, the same family in fact as Kolingi, Avari, Pongam, all of which are selected by ryots especially valuable for green manure. Farmers have found out by experience that such leaves as these are the best for wet lands, but investigation has shown the reason, namely, that these plants contain more nitrogen than others, and that such plants and only plants of this family are able to make use of the nitrogen which is in the air. Nitrogen is the most valuable ingredient of all manures, and if nitrogen was not present in, for instance, a poonac, the latter if applied to a crop would not give it that healthy dark green appearance which always follows an application of poonac on a well-drained soil. Hence, though the farmer, when he sows a green manure crop does not put any manure into the ground, such plants as are described below can collect nitrogen from the air. This is not all, for, except the ash of the plant, all the vegetable matter, which, when ploughed in, rots and improves the texture of the soil, is also obtained by the plant from the air. Hence, growing green manure crops is most profitable, especially if village ashes are also applied at the time of puddling.

Sunnhemp, indigo, wild indigo, cow-gram, groundnuts and daincha (*Sesbania aculeata*) are all plants which can be grown under certain conditions for green manuring.

Sunnhemp.—This is perhaps grown more largely than any other green manure crop. Every year large areas are grown in the Kistna and Godavari Deltas. The seed is sown just before the paddy is harvested and the crop is cut when 4-5 feet high. It is cut at about a foot from the ground and the stubble is allowed to remain and grow again. The tops are dried and make excellent fodder. The sunnhemp, however, on account of its extraordinarily rapid growth can be utilised in many places and under other conditions. In six weeks the crop will attain a height of 3 to 4 feet if the ground is moist. Thus, on wet land, where water is always available, or on wet lands where the seed beds are not prepared until water is available, or again on wet lands under tanks where the latter have been filled by early rains and the season for transplanting has not arrived, under all these conditions sunnhemp can be grown. On the Tanjore delta excellent crops can be raised after the receipt of water in the channels in time to plough in before the seedlings are ready. Again, the heavy summer rains which last year fell in many districts filled many tanks which did not expect their supply till June-July. On the Coimbatore Agricultural Station advantage was taken of this water to grow an excellent crop of sunnhemp, which was ready to be ploughed in by the time the seedlings were ready to transplant. On the West Coast also

this can be grown with the April-May rains, and will be ready to plough in by the time transplanting commences. When grown on only a small scale, people who try this for the first time are apt to be disappointed as the crop is very liable to be eaten by caterpillars, but on a large scale of 3-4 acres the attack is much less. This remark applies to nearly all green manure crops. Some trial fields are often the the only green crop in the neighbourhood and therefore are very liable to be attacked by insects, but when once the practice becomes widespread, so do the insects and the attack is not so severe.

Indigo.—This is a very useful crop to grow for green manure. It is very drought-resistant and at the same time will grow on heavy land even when it is wet, but it will not thrive on land at all saline. It is now largely grown on the Cauvery delta. The seed of this crop can be sown at the time of the harvest of the samba crop. If there is sufficient moisture in the soil for germination, the land can be ploughed and sown as soon as possible after harvest. If it is too dry or too sticky, the seed can be sown a week or two before the paddy harvest, provided the water has been drained off. In the Perambalur taluk there is an excellent practice on tank lands of sowing indigo with cumbu and irrigating from wells. The cumbu when ready for harvest is cut and the indigo is allowed to grow and gives an excellent crop. This is ploughed in at the time of transplanting the samba crop.

Wild Indigo.—This was dealt with fully in last year's Calendar in the note on improvements in the cultivation of paddy on the Sivagiri home farm.

Cowgram.—This promises to be a very useful green manure crop on the West Coast. It grows quickly and is not so liable to insect attacks as sunnhemp. It can be sown with the April-May rains, and will have grown sufficiently to plough in by the time transplanting commences in June-July.

Groundnuts.—This also promises to be a very useful green manure crop on the West Coast on single crop lands which are harvested in October. The land can be ploughed after the paddy harvest and the seed sown behind the plough. The crop should give sufficient nuts to pay for the cultivation expenses while the tops can be ploughed in. This has been tried most successfully at the Taliparamba Agricultural Station, and under similar conditions in the neighbourhood, but it has yet to be proved whether it will do equally well on the lighter and more exposed lands near the coast which do not get the nightly dews which are experienced in the valleys.

Daincha.—This plant will prove very useful on land which is liable to flooding or are badly drained or slightly saline. It grows to a height of 6-8 feet and will continue to grow for several months. It can, however, be ploughed in within four months if necessary. This should prove very useful in the Cauvery delta on such lands which are too wet to transplant with the first crop.

THE ROTHAMSTED EXPERIMENT STATION.

(From the *Gardeners' Chronicle*, XLVII., 1, 201, January, 1910.)

The important part played by the Rothamsted Experiment Station, in the development of scientific agriculture is recognised throughout the world. Since its foundation by Messrs. Lawes & Gilbert in 1843, it has been in the foremost rank of agricultural research institutions. From the days when it played a leading part in solving the mystery of the source of nitrogen to plants, till the present time, it has continued to make contributions to knowledge which have advanced science and assisted practice. At no time during its long and distinguished career has the station been more active than it is now in the investigations of the problems, particularly those appertaining to the soil, which concern the agriculturist and horticulturist.

This being so, it might be supposed that, whatever was the case with younger and less proved situations, the endowment of Rothamsted would be adequate for its requirements. Far from this being the case, it is a fact that the income available for the work of the station is less than that enjoyed by any-one of the fifty-two separate experiment stations attached to the several states of the American Commonwealth.

Thus, although no State Experimental Station exists in this country, our only institution, which, by its work, has won for itself world-like recognition, is allowed to depend for its resources on private munificence, on the support of one of the great City companies and on casual subscriptions. We are not aware that Rothamsted receives any support whatever from the State, but in any case, it must be admitted that for the work of Rothamsted to be curtailed for lack of funds is a reproach to the whole community.

Despite the fact that the society for extending the Rothamsted experiments were founded in 1904, and notwithstanding the activity of this society, the collected donations which it has received amount only to £500 and annual subscription to about £150.

It is impossible to believe that this is a measure of the recognition by the public of the services which the station is rendering. Rather it must be taken as one of the most striking of many indications that insufficient consideration is given to the pressing need for the investigation of problems which concern the national life and well-being. The State leaves such matters too much to private munificence, and the demands are so varied and heavy that our institutions are apt to suffer.

If Rothamsted were in any other country of the civilised world, it would receive an adequate measure of State assistance. The fact that it is not under State control should be no bar to its receiving such aid.

We claim to be a nation of practical men and not of pedants, and yet by heedlessness we fail to invest a few hundreds a year in an enterprise which, even now, handicapped as it is by lack of means, is equal to any experiment station in the world. We hope that before long Rothamsted may receive a substantial grant from the Treasury, and we would urge on the Board of Agriculture the importance of its taking the initiative in securing such a grant.

To state the objects for which funds are required is to demonstrate the urgency of the need. They include: an increase of land for experimental purposes, a permanent endowment for the bacteriological laboratory, equipment of the botanical and pathological departments, and also the investigation of animal nutrition.

The present staff has proved its capacity to elucidate in brilliant fashion the problems of the soil in relation to the growth of crops. It is certain that, with more adequate support, it would contribute in a notable degree to the solution of outstanding problems in other departments of agriculture and horticulture.

INDUSTRIAL ALCOHOL AND ITS POSSIBILITY AS A SOURCE OF POWER IN THE PHILIPPINES.

(From the *Philippine Agricultural Review*, Vol. II., No. 11, November, 1909).

Alcohol can be used as a motor fuel for all purposes for which gasoline is at present employed. Exhaustive tests made by the United States Government have demonstrated that any gasoline or kerosene engine of ordinary type can with proper manipulation operate with alcohol without material change in its construction. The engine will give slightly more power (about 10 per cent.) when alcohol is used, but this increase is at the expense of greater consumption of fuel. Experiments of United States Geological Survey have shown that when denatured alcohol is employed the lowest fuel consumption is obtained with the highest practical degree of compression (11·6 to 13·7 kilograms per square centimeter), but since the vaporization temperature of alcohol is higher than that of gasoline a modified combustion chamber and carburetor is to be preferred. Some gasoline engines are not sufficiently heavy to stand the desired explosion pressure when alcohol is used, and therefore a machine especially designed for alcohol is preferable to one planned to operate with gasoline or kerosene.

The United States Geological Survey made a series of over 2,000 individual tests, comparing gasoline of about 0·699 specific gravity (73° Baumé) and commercial fully denatured alcohol. Tests which corresponded in the method of manipulation showed that alcohol was more efficient than gasoline, and they also proved that equal volumes of gasoline and alcohol produced the same power. This result is not usually achieved in practice. Ordinary commercial gasoline engines of stationary or marine type will consume from 1·5 to 2 times as much alcohol as gasoline when operated under the same conditions.

Alcohol is especially suited to air-cooled automobile engines, as the exhaust is not so hot as when gasoline or kerosene is used, while on the other hand the temperature of the cylinder may be hotter without danger of backfiring. The storage and use of alcohol in engines is much less dangerous than that of gasoline or petrol, and the engines operating on the former run more quietly and produce a less offensive odour. No more skill is required to operate an alcohol engine than one arranged for gasoline or kerosene.

The relative heat values of gasoline, alcohol, and coal are shown by the following approximate numbers:—

	Calories.
Gasoline	11,100
Alcohol (100 per cent.)	7,183
Pennsylvania anthracite ...	7,500

The calorific value of alcohol is of course lower by impurities, so that commercial (90 per cent.) alcohol has a

calorific value of about 60 per cent. of that of gasoline, or a comparative heat value of over 70 per cent, by volume. Alcohol of 85 per cent. is the common grade of industrial alcohol used in Europe. The United States Geological Survey found difficulties in starting and regulating when the experiments employed 80 per cent. alcohol and the fuel consumption increased more rapidly than the percentage of alcohol decreased.

The effect upon motors, lamps, etc., of using denatured alcohol has been discussed, and deterioration has usually been attributed to the denaturant. It may be possible that all of the evils coming from the latter may be remedied in the future. Luke and Woodward found that the interior of an alcohol engine had no tendency to become sooty, as is the case with gasoline and kerosene, and there was no undue corrosion of the interior due to the use of alcohol.

The raw materials from which industrial alcohol comes consist of those substances which contain starch, sugar, and other fermentable bodies, named in the order of their importance, capable of easily being converted into a fermentable sugar. The cereals, rice, wheat, oats, rye, maize, and barley, the potato, cassava or manioc, and some other roots contain large percentages of starch. From all of these as well as from sugar cane and sugar cane molasses, sorghum, and fruit juices which contain large percentages of sugars, alcohol is made. The artichoke which contains neither starch nor sugar but a number of other fermentable carbohydrates, of which inulin and levulin are the principal constituents, has been highly recommended and rather extensively used in Germany for the manufacture of alcohol. At the present time alcohol is made on a large commercial scale from corn, rye, potatoes, sugar beets, sugar cane, and sugar cane molasses. Rice has the largest percentage of starch among the cereals, but it is not the cheapest source of alcohol. Indian corn, which hitherto has formed the chief raw material for fermentation and distillation, contains approximately 70 per cent. of fermentable bodies, and under the best conditions a kilo of corn will usually yield about 340 grams of alcohol (420 cubic centimeters of 95 per cent. alcohol by volume at 15° C.). If the average price of corn be placed at 3 centavos per kilo and the cost of manufacture, storage, profit, etc., be taken as an equal amount, industrial alcohol (95 per cent.) from this source, untaxed, would sell wholesale for about 14 centavos a liter.

Country.	Retail price per liter in centavos.	Annual consumption (million liters).
Germany ...	16	140
Cuba ...	21	...
France ...	23	40
England ...	..	15
United States ...	32	13

Besides rice, Indian corn, sugar cane, the available sources from which alcohol can be manufactured in this Archipelago are the sap of many palms and the cassava. At present nearly all of the alcohol produced comes from the bled sap of the nipa and other palms. Alcohol from the nipa has a disagreeable odour which is somewhat difficult to remove, but for industrial purposes this would be no consequence. A description of this palm (*Nipa fruticans*, Wurmb.) may be found in many places. It is a species widely distributed all the way from India to Malaya, in northern Australia and Polynesia. A very detailed study of the culture and bleeding of this palm has been published by Ayala & Co.

The nipa grows in low, salt-water tidal swamps and the plant is completely developed in about four years after planting the seed. The palms fruit about every two years, at no particular season. When the tree is ready to bleed the fruiting stem is cut as close to the young fruit as possible and the emerging liquid (*tuba*) caught in a joint of bamboo. Every day a thin slice is cut from the stem before all the tuba can be drawn.

The production of tuba from a mature tree usually increases during the first fifty to sixty days after tapping and decreases during twenty-five to thirty days more. If tuba is drawn for a longer period the tree will die. The tuba from mature stems is white, has an aromatic odour, and is sweet. That from palms having less mature fruit is bluish and less sweet and, therefore, has less fermentive value. The average yield per tree fluctuates from one-half to 3 liters per day, with a total of from 30 to 40 liters (sp. gr. 1·07 to 1·08 at 15°). The juice contains approximately 12 per cent. of fermentable material which is largely sacchrose. Thirty-two to 34 liters of tuba will usually produce one liter of pure alcohol. In the Provinces of Bulacan and Pampanga, where the price of the molasses residues from sugar cane is low, the latter is mixed with the tuba before fermentation, and is said to give a larger yield of alcohol than would the two if fermented separately.

Alcohol is removed from the fermented tuba by distillation. The method used

in the provinces produces a distillate containing about 50 per cent. of alcohol. By redistilling a sufficient number of times 95 per cent. alcohol might be produced, but the process would be very expensive; therefore, the crude alcohol is shipped to the large distilleries in Manila, where it can be refined more economically. In the latter, the process is continuous; the vapours pass through several stills and are cooled just sufficiently to condense them in each one until the proper purity is reached. It will, therefore, be seen that after an alcohol once passes the crude 50 per cent. stage a purity of 95 per cent. can be produced with very little more expense per proof liter than one of lower grade. The economy of the purer form is obvious.

The manufacture of alcohol from tuba is rather expensive, and it is doubtful if the process could be greatly cheapened. Denatured alcohol (95 per cent.) from this source is sold wholesale at P2·40, Philippine currency ($1·20, United States currency) per 15 liters, while the above estimated price for the product from corn would be P2·30 per 15 liters. If a market for alcohol as a fuel were opened it could undoubtedly be produced from tuba for P2 per 15 liters, but with the present spasmodic usage it cannot be sold at that figure.

Cassava is sold in the United States over a large area of the South Atlantic and Gulf States, and numerous analyses made by the division of chemistry, United States Department of Agriculture have shown that the roots contain about 30 per cent. of starch. With the exception of cereals it contains the largest amount of fermentable matter.

"An average crop of cassava in the United States may be placed at 5 tons of roots per acre on the ordinary lands of Florida, with proper preparation and cultivation a yield of from 4 to 7 or perhaps 8 tons per acre may be reasonably expected." At present there are no reliable figures on the amount that can be produced on a given area of land in the Philippines. R. F. Bacon thinks that it is perfectly safe to figure on a production of 22½ metric tons per hectare (10 tons per acre). "With this yield," he says, "there is only one other substance which seems able to compete with it as a source of alcohol, namely, the molasses residue from the crystallization of cane sugar." E. B. Copeland estimates that when starch made from cassava sells at its present local price (15 centavos per kilo), alcohol from the same source would be worth about 17½ centavos per liter or P2·60 per 15 liters.

At present prices, it would be more profitable to produce starch than alcohol at a price below the latter figure. If at any time the production of cassava becomes more abundant and the utilization for other purposes less remunerative, alcohol from this source may be placed on the market very cheaply.

Some experiments with alcohol were carried out in Manila a few months ago with the 25-horsepower motor road roller purchased by the city of Manila. In all cases the machine was operated on a level road and at a standard speed. A crude alcohol such as is shipped to Manila by provincial distillers was used. The motor was first heated to a slight extent by being run for about ten minutes with gasoline; it ran for twelve minutes on the alcohol and then stopped. An examination showed that the explosion of the alcohol did not furnish enough heat to evaporate all of the water present, and that a quantity had collected in the combustion chamber. When 90 and 94·5 per cent alcohol were employed the motor ran smoothly, with a consumption of 1·8 and 1·6 times, respectively, the quantity of gasoline used for the same time. Duke and Woodward say that a small engine required 1·8 times as much alcohol (probably 85 per cent.) as gasoline per horsepower per hour.

The utilization of alcohol as a fuel is an established fact. The economy is the only open question. Gasoline (73°) is now sold in Manila at P2·38 per 15 liters (about 16 centavos per liter). On the basis of an engine consuming 1·5 times as much 95 per cent. alcohol as gasoline, the former would need to be sold at P1·60 per 15 liters in order to compete with the latter. In localities where alcohol can be produced cheaply, and which are remote from gasoline supply, alcohol may immediately compete with gasoline as a power fuel, otherwise it is not probable that it will be as economical a fuel as gasoline in these islands for some time to come, and I do not anticipate an immediate change in our motor fuel.

TILLED AND UNTILLED SOIL.

BY J. J. WILLIS, Harpendenden.

(From the *Gardeners' Chronicle*, No. 1195, Vol. XLVI., Nov. 1909.)

The operation of tillage has, for its primary object, the stirring and loosening of the soil. When soil-particles are massed loosely, as in a tilled field or garden, spaces exist between them, and these spaces permit of free movement of air. If the particles are

packed together tightly, as in pasture land where the soil cannot be loosened, there is comparatively little space between the particles, and consequently the amount of air in the soil is but small. All grass land, as compared with that under tillage, is insufficiently ærated, and in most cases the older the sod the less well ventilated it is; for, as time passes, the soil-particles become more closely packed. The ideal soil may be compared to a sponge, not only because of its capacity for holding nutritive solutions, but because of its permeability to air. There can be no question that the high productiveness of well-cultivated soils is due largely to the greater amount of air available for the roots.

The presence of air ensures both oxygen and carbonic acid in the soil. Oxygen is essential to the growth and well-being of the roots of plants, no less than to the ærial parts. Carbonic acid plays an important, though indirect, part in ensuring soil fertility by bringing inorganic materials into solution and thus augmenting the supply of mineral food-substances.

Beneficial micro-organisms are found in greater numbers and are better distributed in a cultivated soil than in compact and uncultivated soils. These lower forms of life, like the higher forms, are profoundly affected, both as to their individual well-being and as to their multiplication, by such conditions as food, air, moisture, and temperature, all of which factors are better regulated by cultivation.

One of the objects of tillage is to convert the soil into a suitable living place for micro-organisms through the increased humus, good drainage, ventilation and higher temperature. It is not unreasonable, therefore, to assume that the greater number and better condition of the micro-organisms in a tilled orchard contributes to the well-being of the fruit trees.

There is evidence to show that all plants, to a greater or less degree, so change the soil in which they grow as to make it wholly or partially unfit for a succeeding crop of the same kind. Different crops growing in the same soil may injure each other, or the one the other. Two theories are advanced to explain these antagonisms of plants. One is that plants excrete toxins; the other is that the injurious effect is the result of bacterial activity.

Mr. Spencer Pickering, of the Woburn Experimental Fruit Farm, in accounting for the injurious effect of grass upon young Apple trees, attributes the harm done neither to competition between grass and tree for moisture and food nor to a difference in temperature. He holds that it is due, not to a lack of air and oxygen, nor to excessive amounts of carbonic acid, but to some "actively malignant" effect on the trees, some action on them akin to direct poisoning. More recently, Mr. Pickering leaves the question open as to whether the harmful action is the effect of a poison (toxin) excreted by the roots of the grass, or whether it is the result of some change in the activity or composition of the micro-flora brought about by the grass sod. Beside these specific experiments with Apple trees and grass there have been recently several investigations with other plants to show that vegetable organisms have interdependences other than those with their physical environment. For example, investigations with Peach trees grown in pots with several other plants show that the Peach does not thrive if its roots are in close proximity to those of certain other plants.

The well-being of nearly all plants which minister to the needs of man is improved by tillage. Fruit trees not only respond to high cultivation in the nursery row, but they need good treatment after transplantation to the orchard.

In experiments to determine what are the comparative effects of tillage and grass sod on the Apple tree, it is found that tillage is generally better than sod, but it should not be expected, however, that sod will be deleterious in the same degree under all conditions.

It is reasonable to suppose, for instance, that in a deep soil, where the Apple tree roots can escape from the grass roots, or in one containing a great amount of soil moisture, the harmful effects of the grass will not be so marked as in cases of an opposite nature. Investigations do not show that the Apples cannot be grown in sod. There are many orchards which prove the contrary. It is suggested, however, that Apples thrive in sod, not because of the sod, but in spite of it. The proof that there are many thrifty orchards in grass sod is not proof that these orchards would not do better under tillage.

The statement is often made that trees will become adapted to grass. There is nothing in the experiments conducted in this country or in the Colonies to indicate that such is the case. Trees planted in sod begin to show ill-effects even in the first year in which orchards are laid down to grass, and each succeeding year but adds to the injury. Trees can hardly be expected to become adapted to thirst, starvation, asphyxiation and poisonous excretions.

MARKET RATES FOR TROPICAL PRODUCTS.

(From Lewis & Peat's Monthly Prices Current, London, 16th February, 1910.)

	QUALITY.	QUOTATIONS.
ALOES, Socotrine cwt.	Fair to fine	80s a 85s
Zanzibar & Hepatic ,,	Common to good	40s a 70s
ARROWROOT (Natal) lb.	Fair to fine	6d a 7d
BEES' WAX, cwt.		
Zanzibar Yellow ,,	Slightly drossy to fair	£6 12s 6d a £6 15s
Bombay bleached ,,	Fair to good	£7 10s a £7 12s 6d
,, unbleached ,,	Dark to good genuine	£5 10s a £6 7s 6d
Madagascar ,,	Dark to good palish	£6 10s a £6 15s
CAMPHOR, Japan ,,	Refined	1s 6¼d a 1s 7½d
China ,,	Fair average quality	136s
CARDAMOMS, Tuticorin	Good to fine bold	2s a 2s 6d
	Middling lean	1s 9d a 1s 10d
Tellicherry	Good to fine bold	2s a 2s 3d
	Brownish	1s 6d a 1s 9d
Mangalore ,,	Med brown to fair bold	1s 10d a 2s 8d
Ceylon.-Mysore ,,	Small fair to fine plump	1s 4d a 2s 11d
Malabar ,,	Fair to good	1s 3d a 1s 4d
Seeds, E. I. & Ceylon ,,	Fair to good	1s 7d a 1s 8d
Ceylon Long Wild ,,	Shelly to good	6d a 1s 9d
CASTOR OIL, Calcutta ,,	Good 2nds	3⅛d a 3¼d
CHILLIES, Zanzibar cwt.	Dull to fine bright	40s a 45s
CINCHONA BARK.—lb.		
Ceylon	Crown, Renewed	3⅝d a 7d
	Org. Stem	2d a 6d
	Red Org. Stem	1¾d a 4¼d
	Renewed	3d a 5¼d
	Root	1⅞d a 4d
CINNAMON, Ceylon 1sts per lb.	Good to fine quill	10d a 1s 4d
2nds	,, ,,	9d a 1s 2d
3rds	,, ,,	7½d a 11½d
4ths	,, ,,	6½d a 9½d
Chips, &c..	Fair to fine bold	2⅝d a 3⅛d
CLOVES, Penang lb.	Dull to fine bright pkd.	1d 5s a 1s 6d
Amboyna ..	Dull to fine	9d a 10d
Ceylon ..	,, ,,	9d a 10d
Zanzibar	Fair and fine bright	5⅛d a 5⅝d
Stems ..	Fair	2d
COFFEE		
Ceylon Plantation cwt.	Medium to hold	65d a 100s
Native	Good ordinary	nominal
Liberian ,,	Fair to bold	43s a 55s
COCOA, Ceylon Plant. ,,	Special Marks	60s a 75s
	Red to good	53s a 59s
Native Estate ,,	Ordinary to red	39s a 53s
Java and Celebes ,,	Small to good red	30s a 85s
COLOMBO ROOT ,,	Middling to good	20s a 22s 6d
CROTON SEEDS, sift. cwt.	Dull to fair	47s 6d a 50s
CUBEBS ,, ,,	Ord. stalky to good	110s a 120s
GINGER, Bengal, rough ,,	Fair	40s nom.
Calicut, Cut A ,,	Small to fine bold	65s a 85s
B & C ,,	Small and medium	55s a 60s
Cochin Rough ,,	Common to fine bold	44s a 50s
	Small and D's	42s 6d
Japan ,,	Unsplit	42s
GUM AMMONIACUM ,,	Sm. blocky to fair clean	35s a 73s 6d
ANIMI, Zanzibar	Pale and amber, str. srts.	£16 a £18 5s
	,, ,, little red	£13 a £15
	Bean and Pea size ditto	75s a £14 2s 6d
	Fair to good red sorts	£9 a £13 10s
	Med. & bold glassy sorts	£6 5s a £8 10s
Madagascar ,,	Fair to good palish	£4 a £8 15s
	,, ,, red	£4 a £7 10s
ARABIC E. I. & Aden ,,	Ordinary to good pale	25s a 32s 6d nom.
Turkey sorts ,,		30s a 47s 6d
Ghatti ,,	Sorts to fine pale	20s a 42s 6d nom
Kurrachee ,,	Reddish to good pale	20s a 30s ,,
Madras ,,	Dark to fine pale	15s a 25s ,,
ASSAFŒTIDA ,,	Clean fr. to gd. almonds	£9 a 10s 10s
	con. stony to good block	15s a £8
KINO	Fair to fine bright	6d a 9d
MYRRH, Aden sorts cwt.	Middling to good	60s a 70s
Somali ,,	,, ,,	55s a 60s
OLIBANUM, drop ,,	Good to fine white	45s a 50s
	Middling to fair	30s a 40s
pickings ,,	Low to good pale	10s a 25s
siftings ,,	Slightly foul to fine	13s a 15s
INDIA RUBBER lb.	Fine Para bis. & sheets	9s 3d
	,, Ceara ,, ,,	8s 9d
Ceylon, Straits, Malay Straits, etc.	Crepe ordinary to fine..	9s a 9s 4d
	Fine Block	9s 6d
	Scrap fair to fine	7s 3d a 7s 8d
Assam	Plantation	5s 6d a 6s
	Fair II to ord. red No. 1	4s a 6s 5d
Rangoon	,, ,,	3s a 3s 6d

	QUALITY.	QUOTATIONS.
INDIARUBBER. *(Contd.)*		
Borneo	Common to good	2s 2d a 3s 3d
Java	Good to fine red	2s 10d a 4s
Penang	Low white to prime red	2s 6d a 3s 2d
Mozambique	Fair to fine red ball	5s a 5s 9d
	Sausage, fair to good	4s 8d a 5s 8d
Nyassaland	Fair to fine ball	4s a 4s 8d
Madagascar	Fr to fine pinky & white	3s 6d a 4d
	Majunga & blk coated	2s 10d a 3s 2d
	Niggers, low to good	1s 6d a 3s 6d
New Guinea	Ordinary to fine ball	3s 2d a 4s 2d nom
INDIGO, E.I. Bengal	Shipping mid to gd violet	2s 10d a 3s 8d
	Consuming mid. to gd.	2s 6d a 2s 10d
	Ordinary to middling	2s 2d a 2s 5d
	Oudes Middling to fine	2s 6d a 2/8 nom.
	Mid. to good Kurpah	2s 2d a 2s 6d
	Low to ordinary	1s 6d a 2s
	Mid. to fine Madras	1s 5d a 2s 4d
MACE, Bombay & Penang per lb.	Pale reddish to fine	1s 11d a 2s 4d
	Ordinary to fair	1s 8d a 1s 10d
Java	,, good pale	1s 7d a 2s
Bombay	Wild	4d a 5d
MYRABOLANES, cwt	UG and Coconada	5s a 5s 6d
Bombay ,,	Jubblepore	5s a 6s
	Bhimlies	5s 3d a 6s 6d
	Rhajpore, &c.	4s 9d a 5s 6d
Bengal ,,	Calcutta	5s 6d a 6s
NUTMEGS— lb.	64's to 57's	1s a 1s 6d
Bombay & Penang ,,	110's to 65's	4¾d a 1s
	160's to 115's	4d a 4½d
NUTS, ARECA cwt.	Ordinary to fair fresh	15s a 17s 6d
NUX VOMICA, Cochin per cwt.	Ordinary to good	9s a 11s 6d
Bengal	,, ,,	6s a 6s 6d
Madras	,, ,,	6s 3d a 8s
OIL OF ANISEED ,,	Fair merchantable	4s 6d
CASSIA ,,	According to analysis	3s 6d a 3s 10d
LEMONGRASS ,,	Good flavour & colour	2½d a 3d
NUTMEG ,,	Dingy to white	1¼d a 1¾d
CINNAMON ,,	Ordinary to fair sweet	2¼d a 1s
CITRONELLE ,,	Bright & good flavour	1s
ORCHELLA WEED—cwt		
Ceylon ,,	Mid. to fine not woody...	8s a 10s
Madagascar ,,	Fair	8s
PEPPER-(Black) lb.		
Alleppee & Tellicherry	Fair	3¾d
Ceylon	,, to fine bold heavy	3¾d
Singapore	,, ...	4d a 4½d
Acheen & W. C. Penang	Dull to fine	3½d
(White) Singapore ,,	Fair to fine	6¾d a 3¾d
Siam ,,	Fair	6⅞d a 8d
Penang ,,	Fair	6¼d
Muntok ,,	Fair	7¼d
RHUBARB, Shensi	Ordinary to good	1s 3d a 2s 8d
Canton	Ordinary to good	11d a 1s 2d
High Dried	Good to fine flat	1s a 1s 1d
	Dark to fair round	5d a 6½d
SAGO, Pearl, large	Dull to fine	18s a 20s
medium	,, ,,	16s a 17s
small	,, ,,	15s a 17s
SEEDLAC cwt.	Ordinary to gd. soluble	45s a 60s
SENNA, Tinnevelly lb.	Good to fine bold green	4½d a 7d
	Fair greenish	3¾d a 4¼d
	Common speckyand small	1⅜d a 2¼d
SHELLS, M. o'PEARL—		
Egyptian cwt.	Small to bold	28s a 127/6nom.
Bombay ,,	,,	18s a 127s 6d
Mergui ,,	,, ,,	£5 10s a £9 5s
Manilla ,,	Fair to good	£6 10s a £10 15s
Banda ,,	Sorts	25s a 30s nom
TAMARINDS, Calcutta..	Mid. to fine bl'k not stony	11s a 12s 6d
per cwt. Madras	Stony and inferior	4s a 5s
TORTOISESHELL—		
Zanzibar, & Bombay lb.	Small to bold	1s 6d a 31s
	Pickings	1s a 17s
TURMERIC, Bengal cwt.	Fair	77s 6s
Madras ,,	Finger fair to fine bold bright	19s a 21s
Do. ,,	Bulbs	14s a 15s
Cochin ,,	Finger	17s
	Bulbs	13s 6d
VANILLOES— lb.		
Mauritius 1sts	Gd crystallized 3½ a 8½ in	12s a 18s
Madagascar 2nds	Foxy & reddish 3½ a ,,	11s a 14s
Seychelles 3rds	Lean and inferior	11s a 11s 6d
VERMILION ..	Fine, pure, bright	3s 3d
WAX, Japan, squares	Good white hard	43s

THE SUPPLEMENT TO THE

Tropical Agriculturist and Magazine of the C. A. S.

Compiled by A. M. & J. FERGUSON.

No. 3.] MARCH, 1910. [Vol. VI.

RUBBER PLANTS IN SINGAPORE BOTANICAL GARDENS.

Analytical Notes.

Hevea Brasiliensis.—The latex was obtained from one 32-year-old tree, tapped at 6-30 a.m. No water was added to the latex, and the formalin added was carefully measured, so that the amount of pure latex is known. In the figures given below, this formalin has been corrected for so that they refer to pure latex.

The total yield from this tree at one tapping was 27 fluid ounces of latex. It was thick, white, and of very agreeable odour.

The coagulum obtained by use of acetic acid was analysed and the amounts of several of the other constituents determined. The dry rubber has the following composition:

Rubber	98.14 per cent.
Resin	1.86 per cent,

Albumens were not determined (as they should be for strictly accurate results). Their amount is small compared to the total, and the usual acetone extraction gives figures that are near enough to the truth for all ordinary purposes.

The analysis of the latex is :—

Coagulum	36.29 per cent	Rubber	35.55 per cent
		Resin	0.67 per cent
		Ash	0.07 per cent
Serum olids	2.63 per cent	Organic matter	2.30 per cent
		Ash	0.33 per cent
Water	61·08 per cent	Water	61.08 per cent

The solids soluble in water, (tannins, colouring matters, pentoses, gums, sugars of the inosite group, etc.,) form a brown sweet smelling mass of extremely hygroscopic nature. The strength and appearance of the rubber were very fine. The percentage of 36 per cent. coagulable matter in the latex is very high for Para and is in accordance with the rule that the percentage of rubber in a latex increases as the tree gets older.

Willughbeia Firma.

The specimen was a vine about twelve years old, in the Botanical Gardens, growing in the jungle part of the same. Greatest diameter of stems about 2½ inches. The latex was found to flow most readily from transverse cuts, but coagulated so easily that collection as latex was difficult. Some of the latex was collected as such and added to the clots picked out of the cuts. The rubber was dried in the air and analyzed. The results are:—Rubber, 86·82 per cent.; Resin, 13·18 per cent.

It was a very fine tough rubber, turning very dark-coloured in a short time. Except for the high resin content it is a first-class rubber.

Chilocarpus Enervis.

This latex was obtained from a creeper in the Botanical Gardens. It consisted of a mass of twisted stems around a large cinnamon tree, the largest circumference of any one stem being about five inches. The latex ran quite freely, without coagulating, from transverse cuts on the thickest stems. The reaction was neutral to litmus. Coagulating agents did not act readily, and the whole was evaporated. It then was a white brittle mass, very soft when hot. The latex contained 42 per cent solid matter. Analysis Dry Rubber 25·60 per cent; Resin 74·40 per cent.

The extracted rubber was a light-coloured mass of little strength or elasticity, although not tacky. It seemed to be rubber, but if really such, is very poor. The resin is a pretty white substance, crystallizing well from organic solvents.

Landolphia Heudelotii. (Africa.)

The specimen examined was a bush in the Botanical Gardens, growing in an inferior clay soil. Only a few feet in height with a diameter of about two inches on some of the branches the basal stem being larger. The latex ran very slowly from transverse cuts and coagulated rapidly. The rubber was obtained by picking the clots from the cuts, and was handsome and strong. The analysis of the dry rubber is:—Rubber, 89·50 per cent.; Resin, 10·50 per cent.

The dry rubber is of a clear light brown colour, not tacky, and very strong and elastic. Compared to Willughbeia rubber, it has a better

colour, and the resin content is less. It is, therefore, a better rubber, as far as can be judged without vulcanisation tests.

Tabernaemontana Dichotoma. (India.)

The specimens examined in the Botanical Gardens were trees about fifteen feet high, of a girth near the base of about eighteen inches, and were growing in a very exposed place in poor soil. Two of these trees were tapped on successive mornings. The latex ran slowly. It coagulated in a few hours in the bottle in spite of added formalin. On rubbing between the fingers and thumb it leaves them sticky as a good rubber latex should not do. The solid mass was extracted. The figures on the dry weight are:—Gutta, 25·95 per cent.; Resin, 74·05 per cent.

The latex contained 40·25 per cent of solid material. The extracted gutta seems to be of very good quality, very tough and of a light yellowish colour. It is very hard when cold and softens readily on warming. The resin appears not to contain cinnamic acid esters, although further work would be necessary to decide this point. It would seem as if the extracted gutta might be a very useful substance.

Leuconotis Eugeniifolius.

The specimen examined was a low bush in the Botanical Gardens, a mixture of Leuconotis, Willughbeia and Urceola. Great care had to be taken to trace each stem to its proper leaf. The thickest stems procurable were tapped transversely; a small amount of thin latex was obtained. Acetic acid coagulates this latex readily but on analysis it was found to contain no rubber. The main constituent, comprising 26·19 per cent of the whole latex, is a sticky resin soluble in acetone.

Artocarpus Integrifolia.

The specimens examined were common Jack trees. The latex ran very well from herring-bone tappings. It was thin and very sticky, neutral in reaction to litmus. Attempts to coagulate it were unsuccessful, but it was found the agglutinated solid matter could be separated from the serum by filtration on paper. A small percentage only was found to be insoluble in acetone, and this was found to be a white powder, neither rubber nor gutta percha. Analysis of the latex gave:

	per cent.		per cent
Coagulum ...	26·79	Solid insoluble in acetone ...	2·37
		Resin soluble „ ...	24·42
Serum solids Gums pectins, albumens, etc. ..	8·85	..	8·85
Water ...	64·36	..	64·36
	100.		100.

The resin is a beautiful clear yellow, semi-solid mass, and extremely sticky. This and a powder of unknown nature are the chief components of this latex, it containing no rubber whatever.

Alstonia "Pulai."

The specimen examined was a large *Alstonia angustiloba* tree in the Botanical Gardens. The tree was tapped by the herring-bone system, and the latex ran well at first, but speedily thickened in the cuts as does Dyera latex. It was kept going as well as possible by scraping it down the cuts, and a total of 2 fluid ounces was obtained. Addition of a measured amount of ammonia caused the latex to become much more fluid and turn a bright yellow in colour. It was filtered through a very fine mesh silk gauze to remove dirt, and acidified with acetic acid. It does not coagulate as easily as true Jelotong latex with any ordinary coagulating agent.

Analysis of the dry coagulum is: Rubber 22·28 per cent. and Resin 77·72 per cent.

Analysis of the pure latex gave:

Coagulum	35·74 per cent.	Rubber	7.83 per cent
		Resin	27·78 „
		Ash	0·13 „
Serum Solids	4·43 „	Organic matter	3·78 „
		Ash	0·65 „
Water	59·83 „	Water	59·83 „
	100.		100.

The latex thus strongly resembles that of the allied Dyera tree. The coagulum, which is rather stiff and brittle when the first excessive amount of water has been removed, contains exactly the same proportions of rubber and resin as in the Dyera Jelotong. The serum solids and the resin are very similar, they may possibly be identical. The resins have all the appearance of belonging to the amyrin group of resin alcohols as do the true Jelotong resins. Some of the chief differences between the two latices are:

(*a*) The inferiority of the Alstonia rubber. The extracted rubber, although it seems to be caoutchouc, is much inferior in strength and colour to Jelotong rubber.

(*b*) Inferiority of Alstonia latex as regards ease of coagulation.

(*c*) Tendency to turn bright yellow of the Alstonia latex. If Jelotong rubber is adulterated with pieces of "pulai" it often is possible to detect the same by the yellow colour. On the other hand if a small quantity of the "pulai" latex is added to the Dyera latex it would be quite impossible to detect it as the dry material of both latices has exactly the same percentages of rubber and resin.

"Purub" Jelotong.

A specimen of Jelotong coagulated by means of "Purub" was examined. This was a large hard ball, yellow outside and slightly so on the inside. It was very hard and brittle and looked very unpromising. The age was said to be about three months. It probably contained some "Pulai."

An extraction showed that the rubber had entirely degenerated to a very sticky gum. In confirmation, a second extraction of a large quantity was made with the same result. The product is, therefore, absolutely worthless.

Manihot Glaziovii.

The specimen examined was taken from a large tree in the Botanical Gardens, Singapore. The bark was quite unlike that of most rubber plants, having a very thin outer bark. This came away from the tree very readily when the knife was used and a large surface of the same was stripped back. On this exposed place, a herring-bone tap was made, retapped again on the following day, and again two days later. The latex tubes are very near the outer surface

of the inner bark, and these few successive tappings did not increase the flow of latex to any appreciable extent. Unlike Hevea brasiliensis, the latex coagulated quickly in the cut, so that the flow ceased almost immediately; in fact, it was quite impossible to collect it in cups for this reason. The rubber collected was obtained by stripping it from the cuts. It had a very disagreeable herb-like odour.

Analysis gave the following figures calculated to dry weight: Rubber 90·44 por cent., Resin 6·83 per cent. and Ash 2·73 per cent.

The rubber is fine and tough, tougher than Plantation Para, and very light straw yellow in colour. The ash could, of course, be reduced to a negligible amount by washing.

CHONEOMORPHA MACROPHYLLA.

The specimen examined was taken from a large vine in the Botanical Gardens, Singapore. The stems were about 3½ inches in diameter, and the base much thicker. It was tapped by a sort of herring-bone system, rather diagonally, and the latex seemed to be quite abundant. It coagulated in the cuts very readily, with about the same ease as Willughbeia firma. As part had coagulated, it seemed impossible to keep the latex in a liquid condition for the time necessary, and it was all coagulatod by rubbing up with the fingers. The rubber was tough and almost odourless. The analysis, calculated to dry weight, is: Rubber 88·63 per cent, Resin 9·19 per cent. and Ash 2·18 per cont.

I should say it is a better rubber than either *Willughbeia firma* or *Landolphia heudelotii*, although the raw rubber is not as tough as either of these two. It has slightly less resin, and a real comparison would require vulcanization tests.

R. B. E.

—*Straits Agricultural Bulletin*, for February.

LECTURE ON RUBBER SANITATION.

MR. GALLAGHER AT JOHORE.

Yesterday at the invitation of the Johore Planters' Association, Mr Gallagher, Director of Agriculture, F.M.S., gave an interesting lecture to a large gathering of members and others at the Johore Hotel. His Highness the Sultan of Johore, himself a rubber planter, Mr D G Campbell, Adviser to the Government of Johore, Messrs. Gawler, Main, Coghlan, Derry, Westenholz, Anderson, Pertile, Dr. Wilson, and many others were present.

Mr W N GAWLER—introduced Mr Gallagher, and welcomed the visitors, regretting that the Chairman and Deputy Chairman of the Association were unavoidably prevented from attending.

Mr GALLAGHER—said that to reach the subject of his lecturó, plant sanitation and diseases of the Para rubber tree, it was necessary to refor to the structure of the rubber tree, and the functions the parts were designed to fulfil. By aid of diagrams he pointed out that the tree was composed, as it were, of layers, coiled round. In the centre was the heart-wood, which for practical purposes was dead, though it still served to impart a certain rigidity to the tree. It might be attacked, by white ants for instance, and the tree would go on living, unless it were blown down. Next to that was the sap-wood, the living wood, which carried up from the roots the nourishment from the soil into the leaves, each of which was a little factory, converting the salts in the soil into nourishment for the plant. The sap-wood was the highway for the nourishment of the tree, which only became useful when it had been in the leaves, suitable to build up the structure of the tree, for the growth of its many parts, for flowers, fruit and for every portion of the tree. The sap-wood had therefore an exceedingly important part to play. The cambium was the next thin layer, not more than a hundredth-of-an-inch thick, and most easily observable when the bark was stripped off, part of it adhering to the strip and part to the trunk. Outside the cambium is the latex layer, and outside that again the bark, which was also very thin. The cambium and the bark were the parts the rubber planter was most interested in, as on either side of the latex and he might say that latex was only a secondary function of the tree, although the latex-layer had the very important part to play of carrying back from the leaves the converted nourishment. The latex layer was the outer highway of the tree. The roots absorbed the food mass below the surface of the soil. But the actual part engaged in that was only about a tenth-of-an-inch long, and as the soil for that part was exhausted, the root structure had to be pushed forward into new ground. Since each part of the tree had its function, it was important for the planter to see that no part was injured, or if they wanted a product from any part of it, that it was not irretrievably injured. For instance, tapping all round must be wrong, because it cut off one of the highways of the tree, the roots got starved, and the treo inevitably died.

Generally speaking, the less of the latex cut away, the better; the cutting should not take away more than half of the tree. If over-tapped, the bark did not renew; nor did the roots get building material for extension. Tho half is better taken in quarters, opposite, because the latex travels with difficulty sideways. This brought round the tapping once in four years.

PESTS OR FUNGUS.

An insect eating a leaf interferes with the functions of the tree. It does not die at once, but is slowly starved. A root or stem fungus (the fungus is a living organism, the seed or some part of it must bo present) by growing to the interference of the tree which is its host. The cells are pierced and perhaps their contents absorbed, or choked. The latex layer is then destroyed and unable to fulfil its functions of supplying food. The same happens if the latex layer is physically destroyed. The water required for the leaves is kept away through the destroyed vascular system. They then wither, and the tree dies away. The root fungus, fomes, presents one important problem to be solved. Fomes is a grave and expensive disease, which has to be dealt with it, but the expense should be looked upon as an insurance. The treatment

by changkolling must be governed by common sense. Fomes is found first on a log, generally, and is transferred to the tree when the roots reach it, once there it grows and eventually the tree dies. It is then necessary to isolate the attacked tree, from fellow trees and from prostrate logs—not to save the tree attacked but to save the others. There was much to be learned about the origin and nature of the pest, but there was no doubt that it attacked the Para rubber tree. The earth 6 in. deep is opened up: if the tree is attacked by fungus, the roots are black; if healthy, white and yielding latex. In guarding against the spread therefore, the area affected must be determined, and then every bit of timber on it burned off. The area is changkolled to eighteen inches, all the timber taken out, and put aside for burning and every bit must be taken out and burned. It is very difficult to kill a fungus and spraying or applications generally could only prevent spreading. Above all things it was absoulutely necessary to be thorough.

Another fungus attacks the stems and branches of rubber trees, showing long streaks of latex down it. It runs on a branch, or the main stem and is rather easily identified, even without a microscope. This black fungus can be cut out of stems, or branches cut off and burned—it seems easily checked. In cutting branches or a stem, the saw should be used after hacking down, and a good slope cut; after which tar should be applied, to prevent other fungus entering. Branches should be cut off close to the stem, when a clean heal results. There is a limit to the amount of tarring a tree will stand, it may survive a narrow strip but not very much. White-washing will keep away deer and rats and will not injure the trees. All remedies have to be applied with knowledge, and his Department were quite willing to supply information and give assistance in any way they could.

DISCUSSION.

In answer to questions, Mr. Gallagher said that "die-back" might be due to several causes. When the fungus he had spoken of attacked trees, this appearance followed. The treatment was to cut off the affected part, three feet below the lowest point to which the disease had reached, and burnt it. It might result from interference with the water supply. Peaty soils were sometimes too acid and careful planters on observing any sign of it tested the water with litmus, and if it proved acid, applied lime. He did not know that fomes was ever more than two feet deep, though he knew of no reason why it should not go deeper. It was exceedingly necessary to be on the look-out for it and to isolate and burn affected plants. In other than peaty soils, charcoaling could be tried. Pink fungus was the stem and branch fungus he had mentioned. He believed it existed in kampongs, and on Java trees. It had not been reported from the Peninsula. Fomes might spread by spores, but he had no information as to that. The colours were very fugitive, and he could not show them any specimens, but if they suspected it, the sample might be sent to the Department, properly labelled, and they would then report on it.—*S. F. Press*, Feb. 7.

THE "STRENGTH" OF OLD AND YOUNG RUBBER.

We have seen it asserted in Ceylon that the theory—the older the rubber, the greatly superior it is in strength—rests merely on the rough and ready practical tests of buyers and manufacturers. Mr. Henry P. Stevens, M.A., F.I.C. in his article in the Quarter-Century number of the *India Rubber Journal* points out the following—among factors other than superior strength (which he does not admit to be inevitable) which tend to assist Fine Para in public popularity as against Plantation:—

(*a*) Fine hard is the specified quality in a number of War Office, Admiralty, and other contracts, and must therefore be used for many goods quite apart from the question of merit.

(*b*) Fine hard is to be had in very large quantities in fairly uniform quality, so that it can be depended on to produce uniform results, while plantation rubber is put on the market in almost every imaginable variety of shape, form and quality. Even when an estate is shipping a product of uniform quality, the quantity in most cases is relatively small. If a manufacturer could depend on getting the greater part of every consignment of the same rubber from a given plantation, the amount would not be more than he would require to keep him going on one or two special lines.

(*c*) Plantation rubber has not yet stood the test of time.

It is stated that local experience and scientific opinion is opposed to the view that old and young trees give rubber of equal strength. But here again we have a valuable opinion on the other side, from the other article by the prominent home chemist above quoted, who has considerable experience of rubber testing as follows:—

The quality of plantation rubber is, of course, largely dependent on the method employed in its preparation. I may here call attention to a recent paper read before the Society of Chemical Industry by Mr. Beadle and myself on 3rd May last. The results of tests detailed in that paper on rubber vulcanised with heat in the usual manner showed that the samples of Ceylon plantation rubber examined were slightly—yet distinctly—inferior in physical qualities to the sample of hard cure Para. Another series of tests on manufacturers' samples of cold cured goods made from hard cure and the best plantation, were in favour of the plantation samples. Another important point was brought out in this work, namely that a difference in the age of the trees, say from five to twenty years old appeared to have little or no effect on the physical qualities of the vulcanised rubbers.

I was glad to notice that Mr. Parkin in this Journal (2nd November, 1908) had come to the same conclusion on purely botanical grounds, and wrote that he should be rather surprised to find any marked difference in the quality of the rubber drawn from ten-year-old trees. as compared with twenty-year-old ones as in both cases the latex is formed from secondary growth and is not comparable with that derived from laticiferous vessels of primary growth in the twigs and leaves.

RUBBER GROWERS' ASSOCIATION.—(CEYLON SECTION).

FUND FOR THE EMPLOYMENT OF A CHEMIST

In Ceylon: To Conduct Experiments with Regard to the Curing of Rubber.

The following circular notice has been issued to rubber-growers:—

Dear Sir(s),—We are desired by this Association to advice Ceylon Rubber Producing Companies and other proprietors of rubber estates in Ceylon that the Ceylon Committee of the Rubber Growers' Association (and a sub-Committee thereof) have, at a series of meetings, had under consideration the question of establishing a research station in Ceylon, and employing a chemist to conduct experiments with regard to the curing of rubber for the benefit of those contributing to the expense.

A group of members of the Malaya Section of the Association (who are interested in rubber production in the Federated Malay States) have arranged a similar scheme, and the experience gained during the course of their enquiries has shown that it is necessary for the work of the research chemist to be technically directed. The Malaya Committee have already entered into an agreement with Messrs Clayton Beadle & Stevens (a firm whose partners are well-known as being experienced in the chemistry of rubber, both raw and manufactured) to direct the work of the chemist who has already been despatched to the F.M.S. to conduct experiments there.

Following on the experience thus gained, the Ceylon Committee have provisionally arranged with Messrs Clayton Beadle and Stevens to direct the work of a chemist who will go out to Ceylon (on behalf of the members subscribing to the expense) and carry out experiments on the subject of the curing and manufacture of plantation rubber. The firm will themselves conduct experiments in London in conjunction with the research work in Ceylon. In all matters, other than scientific direction, the chemist will be controlled by a Committee in Ceylon appointed by those subscribing to the scheme.

It has been decided to ask Ceylon rubber estate proprietors to subscribe to the expenses which, it is estimated, will amount to £1,000 per annum for three years. (The arrangement for the F.M.S. is on a somewhat higher scale). Suggestions for a definite scale of contribution will be considered by a meeting of estate proprietors in Ceylon which will be convened by Mr Joseph Fraser, but it is considered that no contribution from any one estate should exceed the sum of £50 per annum, and that guarantees should be limited to that amount.

We are desired to state that the Ceylon Committee would appreciate an expression of opinion from you, on the scheme as outlined, and an indication that you will favourably consider the question of contributing towards the expense when the proposal is matured.—Yours faithfully,

A Bethune, President.
C Taylor, Secretary.

1, Oxford Court, Cannon Street, London E,C.
December 23rd, 1909.

RUBBER IN MALABAR.

Little has been heard so far of rubber cultivation in Malabar, as compared with the industry in the neighbouring States of Travancore and Cochin, and yet it is making steady progress, more especially in the south of the district. Two large Companies were formed last year, one in London and the other in Holland, to acquire land near Nilambur and Quilandy, respectively, and plant Para rubber thereon, and both are now clearing considerable acreages with this object in view. Still more recently the Kerala Rubber Co. has been floated in London to take over some 2,100 acres, of which over 1,200 acres were planted in 1907 and 1908 at the foot of the Koondahs on the eastern slopes of the Nilambur Valley. In addition to the above, large Syndicates are at work near Munderi and Quilandy, extensive clearings being the order of the day in both concerns.

SOME VERY INTERESTING TAPPING OPERATIONS have been conducted during the last four months by Mr E R Fowke on the Para trees planted between 1883 and 1885 by Mr. T J Ferguson, of Calicut, at Poonur, near Tamarachery, which property has since been acquired by the above-mentioned Dutch Company. There are 135 of the trees altogether, spread over about one acre, and several of them have attained a girth of 7ft. and over at 3ft. above the ground. Tapping was commenced in September last, and so far these trees have yielded 1 lb. of dry rubber per tree each month, a man collecting enough latex to make fourteen biscuits (about 3½ lb.) a day. The produce has been sent to Amsterdam for report, and the opinion of the Dutch brokers should be very interesting.

I also learn that Mr Fowke expects his big trees to continue to yield at the rate of 1 lb. per tree per mensem, making a total yield of 12 lb. per tree in the year. In any case, the results aleady obtained are remarkable and testify to the correctness of the high opinion formed by Mr R L Proudlock, lately Curator of the Government Gardens and Parks on the Nilgiris, as to the suitability of South Malabar and the Nilambur Valley to the cultivation by Para rubber.

The Bomb in Agriculture.

While on the subject of planting in Malabar I must mention a new method of circumventing wild pig, as described to me a few days ago by one who had tried it. The depredations of pig are a great trouble to Malabar agriculturists, and the Government offer a reward for their destruction. This induced an enterprising ryot a short time ago to devise a scheme which is said to have decimated the herds of pig in the Ernad and Walluvanad Taluqs. He prepared a bomb, after the manner of Indian fireworks, and cunningly concealed it in a piece of meat such as all wild pigs love. An ill-fated boar devoured the bait; the bomb exploded and off went "piggy's" head. And now bombing pig is said to be all the fashion among the rustic youth of South Malabar!

Georgos.

—*M. Mail*, Jan. 29.

RUBBER IN BORNEO.

First Tapping on Beaufort Estate.

On January 4, says the *B. N. B. Herald*, the first tapping of cultivated rubber on the west coast, took place on the B. Borneo Para Rubber Co.'s Beaufort Estate. According to a promise of long-standing Mrs Horton, wife of the late District Officer, Beaufort, tapped the first tree, wishing success to the estate and the manager Mr J R Watson whose guests she and Mr Horton were. The tapping took place early in the morning and about 60 trees were operated on. Messrs. Horton and Mulygan took photographs of this historic scene. The Judicial Commissioner, Mr R Bryett Turner, Messrs. J Hatton Hall, H G Hill, C Ashton Pryke and P C Brackenbury, Acting D.O., were also present. After the tapping had been done the party repaired to Mr Watson's house and drank success to him and his estate. This tapping is preliminary only, and it will be a month or two before regular tapping starts when it is hoped that His Excellency the Governor of B. N. Borneo will inaugurate the tapping on a business scale.

RUBBER IN SUMATRA.

A friend, formerly of Singapore, who has been for nearly a couple of years on a rubber estate in Sumatra, appears to be charmed with the prospects of rubber planting there. He writes:—

"Rubber here is booming and from the estate results they are getting or should in time, for its acreage, knock out a great number of F.M.S. estates. The soil up here, 600 feet above the sea is grand; black, rich volcanic stuff. I hope to start tapping here from 4,000 to 5,000 trees in a month or two, and S—— (the same Company) about 8,000 to 10,000 trees this year. Coffee will give a 5 per cent. dividend on 1909, and 1910 will be rather better without counting in the rubber at all. So we have a good future."—*S.F. Press*, Jan. 29.

PARA RUBBER IN FRENCH INDO-CHINA.

We take the following notes on the cultivation of Para rubber in the experimental station of of Ong Yem from the "Bulletin de la Chambre d'Agriculture," October, 1909, p. 455. The trees were planted in 1898, and thus are nearly eleven years old. The average diameter of ten trees is given as ·843 mm. in 1908 and ·895 mm. in 1909. The biggest tree measured 1·26 metre in 1908 (3ft. 3·71 in. about) and 1·35 next year. This may be considered a good growth. These trees were tapped everyday for a year and gave 14 kilos 497, or 1 kilo 449 each, (2 lb. 3 oz. 4 drs. about). the rubber was not quite dry when weighed and allowing for a further loss of 20 per cent, this gives 1 kilo, 160, per tree of ten years old a year. One must not generalise too much on this, as only a small number of trees were tapped. Vernet's method of tapping every two days in a special or half spiral gave distinctly inferior results, but comparison is difficult because of the different sizes of the trees experimented with. The plot at Ong Yem are sandy and poor in fertilising elements, and the growth in such a soil is very satisfactory. The trees produced very vigorous shoots in the dry season in a soil where water is met, with only at a depth of 10 to 12 metres at the end of April. The plantations in Cochin-China are increasing, the larger ones are established on the red sands. The other planters, with smaller areas, prefer the sandy lands near Saigon.—*Straits Agricultural Bulletin* for January.

THE ANTWERP RUBBER TRADE.

According to an Antwerp report on the rubber trade, the

REDUCED IMPORTS OF CONGO RUBBER

into that port last year (772,813 kilos; against 1,119,026 kilos in 1908), is due chiefly to the

ALTERATIONS MADE IN THE LABOUR TAX.

This has been removed from certain classes of natives, who have, therefore, no longer any necessity to collect rubber with which to pay. It is further stated that considerable alterations will be made by the Belgian Government with regard to the rubber trade. The trade will be worked by private interests, the change being made gradually, but to be completed within three years from July 1, 1910. Considerable

CHANGES ARE ALSO TO BE INTRODUCED IN THE SYSTEM OF PLANTING,

as the present arrangement, whereby rubber collectors are supposed to plant a certain number of trees each year, has not worked satisfactorily. A tax of from 20c to 40c per kilo, according to the nature of the rubber, is to be paid on all exported, and this tax is to be applied solely to the planting of new trees which will become Government property. About 5,000 acres of new land will come under cultivation each year, and it is anticipated that this will presently prove a very good source of revenue. Reference is made to the progress made with rubber cultivation in the Far East, land under cultivation in the Malay States and the Straits being estimated at 240,000 acres, in Ceylon at 180,000 acres, and in Java, Sumatra, and Borneo at 50,000 acres, a total of 470,000 acres.—*H. & C. Mail*, Jan. 21.

1909 TEA AND RUBBER CROPS.

Yatiyantota, Ceylon Tea Co.

The Managing Agents in Ceylon cable that the Crops secured were as follows:—Tea—1909 1,588,393 lb, Against in 1908, 1 555,055 lb. Rubber—1909, 14,000 lb. (Approximately), Against 1908, 7,521 lb.—T. A. Williams, Secretary, 8th Jan.

Panawatte Tea and Rubber Estates.

Panawatte and Yogama Estates.—*Tea*—1909, 718,374 lb. Against in 1908, 695,094 lb. *Rubber*—1909 (approximately) 13,300 lb. Against in 1908, 1,102 lb.

Perth Estate.—*Tea*—1909, 212,480 lb. Against in 1908, 240 670 lb. *Coconuts*—1909, 805,000 nuts. Against in 1908, 875,159 nuts. *Rubber*—1909 (approximately) 19,900 lb. Against in 1908, 10,355 lb.—T. A. Williams, Secretary, 8th Jan.

RUBBER OUTPUTS IN THE F.M.S.

SOME QUESTIONS AS TO YIELD OF TREES ANSWERED.

(To the Editor, *Straits Times.*)

Sir,—Much has been written at various times with regard to the output of rubber trees, but prospectuses vary so much in their forecasts that, after perusing a few and comparing some of them, one feels bound to give up the attempt to arrive at any definite and reliable figures from such sources. Would the statistics at your command permit of your publishing what quantity per tree or per acre may be expected as a fair average yield from a European-managed estate? Not from one which shows exceptionally good growth, nor on the other hand, from a backward estate, but a fair average figure for rubber of 4, 5, 6, 7, 8, 9, and 10 years of age respectively, which intending investors might use for the purpose of calculating the prospective output during the next three or four years of the estates now nearing or just started tapping.

If you don't care to publish such a statement, perhaps you would be so kind as to furnish me with the information, for my own use, by letter. I feel sure, however, that many would appreciate its publication.

I enclose my card and remain, yours, etc.,

VERIDICAL.

Singapore, Jan. 30, 1910.

[The question asked by our correspondent is of great interest and importance, and, as he says, it is most difficult to get definite information. We have no objection, however, to giving the calculation made for our purposes as writers on rubber subjects. It is as follows:—

Age of trees.	Yield per single tree.	Yield per acre of 120 trees.
Years.	lb.	lb.
4	¾	90
5	1	120
6	2	240
7	3	360
8	4½	460
9	6	720
10	7	840

The estimate is for estates on good average soil, under competent European management, where all that is possible is done to work for safe immediate, and assured future results. Some will say that more should be put down for the ages 4, 5, 6 and 7, and less for older trees. We do not think so. More may be got from the young trees, but it is at the risk of injuring them unless the conditions are quite abnormally favourable. After the seventh year, trees which have been tapped moderately and with care should be strong, and capable of responding to calls for a larger yield.

We fix the number of trees at 120 per acre because we are convinced that where the number is larger, the yield per tree will be proportionately less.

One of the dangers to young plantations is that the trees may be excessively tapped while rubber prices are high on the principle of "making hay while the sun shines."

A good many estates, especially those laid out by Chinese owners, are too closely planted, and our correspondent and others must not overlook this. Generally, yield per acre on the 120 tree basis is a safer guide than yield per tree.

On most well-managed estates, collection, curing, etc., can be done at a cost of 1s per lb. But there are incidental expenses, losses, etc., to be met, and a probability of labour becoming more expensive. The cautious investor, therefore, should take 1/3 as a fair average cost figure before counting profits on output.—Ed., *S. T.*]

PLANTATION *vs.* FINE PARA RUBBER.

A REPORT FROM SOUTH INDIA.

From the following report of the findings of the Scientific Department of the Department of Agriculture it will be seen that the conclusion that is of the most importance to those interested in the industry is the fact that a series of tests on rubber from 4½, 5, 9, 10, 17, and 27 year old trees show very little difference in the strength of the rubber from the trees of various ages, but the fact remains that the potential strength of plantation rubber of any age is inferior to that of fine Para, and it seems clear that the necessary improvement in the cultivated product can be obtained only through improved method of treatment:—

REPORT ON PLANTATION RUBBER (HEVEA BRASILIENSIS.)

First.—The rubber from young trees is not materially different from those of much greater age, and leads us to the conclusion that the age of the tree from which rubber is extracted is not so important as is generally supposed.

Second.—The potential strength of the plantation product is inferior to that of fine Para.

Third.—Stretch satisfactory for all practical purposes.

Fourth.—The plantation product has slightly less resin than fine Para.

Fifth.—The plantation rubber has slightly less mineral matter than fine Para.

Sixth.—The well-known fact that plantation rubber has from 15 to 18 per cent less moisture than fine Para.—*Planters' Chronicle*, Jan. 22.

BRAZILIAN RUBBER EXPORTS.

UNITED STATES TAKES MORE AND EUROPE LESS FROM PARA.

According to statistics of the shipments of rubber from Para furnished by Consul-General, H Pickerell, the United States takes more rubber from Para than Europe. The following comparative statement for the past three fiscal years ended 30th is interesting (a kilo=2·2 lb.):

	United States.	Europe.
1907	18,276,098	19,390,679
1908	14,658,280	21,764,526
1909	19,062,633	19,172,238

"Contrary to the anticipations of producers," says Mr. Pickerell, "the rubber production of last year has been considerably greater than that of the previous equal period, and was almost reached the amount produced in 1907, the year of greatest production. Notwithstanding this unexpected large yield prices have shown an enormous tendency to rise, and it would seem from present reports that the end has not yet been reached; 1·63 dollars per lb. f.o.b. New York is high when one considers and just a little more than one year ago the same article was selling in the same market for 63 cents. It is too soon to tender any opinion upon the coming season's crop, but I feel sure that every effort will be made to take advantage of the present high price. According to later Brazilian trade figures the rubber shipments from Brazil continue to increase although more in value than in quantity.

AN INTERNATIONAL RUBBER TESTING COMMITTEE.

comprising a number of independent nations, sections united under a common President has been formed, with the following objects in view:—

1. Collection of extra data regarding the various official and unofficial chemical and physical tests applied to raw rubber and manufactured rubber articles at the present time.

2. Consideration of the tests referred to from the point of view of efficiency and expediency.

3. To make recommendations regarding the desirability of maintaining, modifying or abolishing existing methods, of testing, and to suggest if necessary, new methods, and to work these out on a practical basis.

4. To act as an advisory body in cases of doubt or dispute concerning methods of testing.

5. Similarly, if desired, to act as a Board of reference or arbitration.—*India-Rubber Journal*, Dec. 27.

STRANGE GROWTH OF A PARA RUBBER TREE CUTTING.

Mr. Bean sends the following curious note on the behaviour of a Para tree:—"Eighteen months ago on our estate (Puak, Borneo) a 3½ year old tree was blown down and the trunk having been cut in two pieces by the Javanese was used as corner posts for a rough fence. One of these posts had been rammed in the ground upside down and after a month began to grow. In three months there were two shoots eighteen inches long which flowered heavily. No fruit resulted, but that was hardly surprising; however, the cutting is still growing but very slowly." It is not of course an uncommon occurrence for a piece of living wood of almost any tree especially soft wood trees to put out branches or shoots for some time after the cutting is made, using up in so doing all the food which happens to be stored at the time in the bit. After which unless by that time the stick has been able to emit roots and feed itself normally, shoots and stick dies. It is, however, unusual for it to grow wrong way up, or to produce flowers. I have seen, however, a low fence of crossed sticks made of cuttings of branches of Ceara rubber, *Manihot glaziovii* flowering and fruiting quite heavily.—Ed.—*Straits Agricultural Bulletin* for Feb.

A SUGAR-CANE EXPERIMENT.

In North Malabar: R400 Per Acre Profit.

The Manager of the Talliparamba Government Farm, North Malabar, recently experimented with sugarcane on a 25 cent. plot of single crop wet land, and the experiment having been reported to have yielded a net profit that would work out at R400 an acre, Mr R B Wood, I C S, President of the District Agricultural Advisory Council, called for a detailed report, in view to placing the same before the agricultural public. Planting was started early in February, the germinated "sets" being planted in parallel trenches 1½ ft. wide and one foot deep and 2 ft. apart. In all, 1,000 lb. of fish manure and 1,000 lb. of ashes were applied, on three or four different dates. As the canes grew, the trenches were gradually filled in, until by June the ground level was reached. After that earth was still piled on, creating channels that served to drain off the water. On being planted, the canes were watered first daily, then weekly, till the monsoon set in. The chief pest was white ants, and they were kept off by fish manure and ashes. As the canes grew up, they had to be propped up and all rotting leaves were removed. The crop amounted to 5,000 good canes, 10 to 15 ft. long, and the total cost of cultivation was R50. Some of the crop was sold to ryots for seed at R3 per 100, some were sold for eating at one anna and 1½ annas each and 1,200 were milled for jaggery, each yielding on an average half a pound of jaggery. The present price of imported jaggery is 1 anna 8 pies per pound, and at this rate the price of 5,000 canes would work out to R120. This would give a net profit of R210, but the cost of making the jaggery will have to be deducted. Mr. Wood expresses the opinon that sugarcane in this district would pay best if grown for the manufacture of jaggery for local consumption. At present, sugarcane is not regularly raised in this District, although it is systematically cultivated on a considerable scale in the adjoining District of South Canara. In Malabar, it is grown on a small scale here and there, chiefly by Native Christians, but the methods of cultivation are primitive and the produce is inferior. Most of the sugarcane sold in the District is imported from Coimbatore and other parts. A Calicut landowner started a small plantation in the town a few years ago, but does not appear to have met with any great degree of success. However, the excellent results which have attended the Talliparamba experiment may give an impetus to the cultivation of this crop, for which the general conditions seem to be very favourable in many parts of the Malabar District.—*M. Mail*, Feb. 7.

THE COLOMBO TEA TRADERS' ASSOCIATION.

AVERAGES FOR 1909.

Colombo, Feb. 16th.

Summary of Ceylon Tea sold at Public Auction in Colombo for the 12 months ended 31st December, 1909, with the average prices realised :

Estate.	lb.	av.
Monkswood	216,911	58
Glassaugh	220,237	56
Preston	99,584	56
St. Johns	194,915	55
Tullybody	211,782	54
Tommagong	162,659	54
The Scrubs	111,722	54
*Ellawatte	58,080	54
Wanarajah	383,677	53
Westward Ho	136,693	53
Court Lodge	215,347	52
Gonapatiya	179,878	52
Agra Elbedde	91,025	52
*Kenmare	47,975	52
Richmond	5,986	52
High Forest	735,504	51
Agra Ouvah	321,869	51
Maha Uva	306,987	51
Middleton	298,057	51
North Cove	122,879	51
Loinorn	118,495	51
Blinkbonnie	99,580	51
East Fassifern	64,311	51
Glasgow	442,090	50
Denmark Hill	258,229	50
Mocha	247,009	50
Marigold	120,532	50
Naseby	116,968	50
Tientsin	111,845	50
Palmerston	110 694	50
Pedro	334,396	49
Ardlaw and Wishford	190,791	49
Ireby	125,060	49
Upper Ohiya	23,993	49
Ingestre	254,267	48
High Fields	252,121	48
Fairlawn	215,566	48
Hornsey	191,132	48
Theresia	161,800	48
Ormidale	157,686	48
Logie	155,598	48
Detenagalla	133,563	48
Templehurst	132,208	48
Killarney	129,002	48
Fetteresso	88,597	48
Galloola Division	76,365	48
Stafford	63,111	48
Attampettia	215,954	47
Bramley	209,307	47
Coreen	148.925	47
Waldemar	144,394	47
Lucky Land	126,260	47
Stamford Hill	116,922	47
Donachie	108,284	47
Mahanilu	107,657	47
Mount Everest	105,302	47
Dambagastalawa	104,937	47

ESTATE.	lb.	av.
Ladbroke	74,275	47
Callander	72,986	47
Strathspey	66,326	47
*Dovedale	9,499	47
*Kumaradola	1,485	47
St. Clair	449,560	46
Gampaha	344,859	46
Glentilt	290,906	46
Inverness	288,497	46
Tinioya	213,005	46
Queensland	140,057	46
Gonakellie	127,734	46
Kincora	115,697	46
Evalgolla	105,822	46
Warleigh	101,707	46
Nonpareil	90,464	46
Faithlie	85,349	46
Cleveland	82,441	46
Dunnottar	82,076	46
St. Vigeans	81,801	46
Devonford	76,400	46
Kinross	69,994	46
Mossend	29,285	46
Glenorchy	18,475	46
Bunyan and Ovoca	272,487	45
Moray	231,202	45
Lamiliere	227,144	45
Harrow	190,443	45
Deaculla	175,526,	45
Adisham	167,086	45
Gangawatte	160,604	45
Harrington	160,036	45
Newburgh	152,833	45
Winwood	144,885	45
Erlsmere	129,192	45
Amherst	115,456	45
Rookatenne	110,608	45
St. Evelyn	97,186	45
Rickarton	83,763	45
Bittacy	77,887	45
Seenagolle	63,681	45
Holbrook	22,990	45
Melton	18,477	45
Florence	412,230	44
Uvakellie	256,289	44
Invery	236,774	44
Dunkeld	196,821	44
New Valley	188,145	44
Muirburn	156,444	44
Munukettia	132,612	44
Glenanore	126,387	44
Mahagalla	109,347	44
Robgill	108,320	44
Glen Taffe	99,555	44
Annandale	99,027	44
Maymolly	83,884	44
Poolbank	69,174	44
Ravenscraig	63,655	44
*Cranley	57,360	44
Blairlomond	52,905	44

Estato.	lb.	av.
Simla	52,704	44
Maha Eliya	33,915	44
Chrystler's Farm	29,559	44
Somerset	14,447	44
Luccombe	12,922	44
Caledonia	4,410	44
Bandar Eliya	694,279	43
Marlborough	472,945	43
Roeberry	397,122	43
Tymawr	273,867	43
Brownlow	253,037	43
Battalgalla	234,113	43
Templestowe	192,985	43
Bopitiya	189,532	43
Camnethan	167,376	43
* Mount Vernon	167,215	43
Galapitakande	166,150	43
Monte Christo	145,095	43
Kolaniya and Braemar	139,067	43
Elemane	138,297	43
Donnybrook	134,145	43
Gingranoya	124,837	43
Bickley	114,936	43
Minna	112,280	43
Westmorland	107,454	43
Nyanza	107,352	43
Mousakellie	100,146	43
Beauvais	93,943	43
Hatton	92,237	43
Little Valley	82,505	43
Grange Gardens	82,260	43
Eton	69,583	43
Queenwood	68,713	43
Wellington	64,945	43
Craigmore	52,670	43
Ben Nevis	37,679	43
Carfax	25,706	43
*Summer Hill	22,890	43
Batgodde	19,799	43
Ardlaw	6,838	43
*Ragalla	6,715	43
*Bon Accord	5,780	43
Puthukadu	5,341	43
*Scarborough	3,902	43
*Bathford	1,780	43
Verelapatna	363,626	42
Tonacombe	344,146	42
Great Valley	286,770	42
Oonoogaloya	263,675	42
Ottery	247,404	42
Shawlands	234,109	42
Kirklees	202,612	42
Avon	185.509	42
Nahavilla	181,235	42
Queenstown	181,217	42
Clarendon	145,167	42
Dunbar	138,762	42
Mansfield	135,842	42
Cabin Ella	134,484	42
Rahatungoda	131,087	42
Bowlana	129,711	42
Yelverton	112,591	42
Columbia	99,776	42
Wattagollie	79,761	42
St. James	75,608	42

Estate.	lb.	av.
Whyddon	70,010	42
*Avondale	69,839	42
Cecilton	69,667	42
Mincing Lane	59,478	42
Meath	58,537	42
*Forest Creek	57,478	42
Sudbury	44,196	42
Appachy Totum	35,831	42
*Troup	29,085	42
*North Pundaluoya	22,390	42
Midlothian	18,373	42
*Meeria Cotta	15,833	42
Ritnageria	10,195	42
*Rosita	6,966	42
Sylvakandy	566,525	41
Rookwood	367,136	41
Battawatte	280,991	41
Castlereagh	211,954	41
Koslande	184,600	41
Nadoo Totem	136,013	41
Oakwell	134,101	41
Glengariff	126,347	41
Galleheria	124,235	41
Old Medegama	116,387	41
Dickapitiya	116,231	41
Manickawatte	110,986	41
Panmure	110,435	41
Hangranoya	105,495	41
Madulkellie	103,879	41
Coventry	102,370	41
Rilpolla	98,577	41
Oodooweera	97,627	41
Agratenne	88,520	41
Errollwood	88,470	41
Cobo	47,229	41
Lyegrove	45,849	41
Anningkande	40,860	41
Doonhinda	38,325	41
Genekeriya	23,770	41
Theydon Bois	23,685	41
*Waverley	19,111	41
St. Mary	17,080	41
Wattumulla	14,095	41
Namunukula	13,781	41
Udapalate	13,154	41
*Wallaha	10,254	41
*Iona	8,352	41
*Forres	6,703	41
Elmshurst	4,852	41
*Emelina	3,216	41
*Hindagalla	2,047	41
Ambragalla	555,357	40
Dammeria	315,447	40
Orion	296,587	40
Swinton Division	267,306	40
Poonagalla	227,166	40
Oonanagalla	218,911	40
Myraganga	196,771	40
Talgaswella	191,210	40
H G M	181,150	40
Halloowella	180,925	40
Macaldeniya	163,206	40
Cotta	150,170	40
Baddegama	146,672	40
Opalgalla	139,623	40

* Denotes Incomplete Invoices.

Estate.	lbs.	Av.
Kolapatna	135,333	40
Unugalla	117,132	40
Meeriatenne	113,244	40
Walton	105,105	40
Hardenhuish	103,213	40
Weygalla	93,913	40
East Land	80,683	40
Osborne	73,167	40
Halugalla	72,031	40
Ampitigodde	71,839	40
Rambodde	70,764	40
Bowhill	61,428	40
St. Clive	58,789	40
*Birnam	56,605	40
Letchmey	51,440	40
Glenfern	49,785	40
Temple Land	47,727	40
*Glenugie	38,693	40
*Donside	37,063	40
Gwernet	34,015	40
Hyndford	14,805	40
*West Holyrood	12,756	40
*Spring Valley	11,120	40
*Mandara Newera	7,056	40
Nallathanne	3,549	40
Marie Land	366,275	39
Deviturai	342,778	39
Choisy	337,228	39
Panilkande	313,977	39
Mossville	274,310	39
Tempo	253,896	39
Hantane	221,197	39
Tismoda	215,020	39
Hanagalla	210,949	39
Penhros	200,273	39
Morahela	184,467	39
*Bullugolla	180,935	39
Natuwakelle	174,225	39
Waragalande	143,892	39
Coldstream Gp.	131,687	39
Hatherleigh	127,726	39
Leangapella	124,425	39
Gallinda	102,423	39
Keenagaha Ella	95,273	39
Bollagalla	89,680	39
Ohiya	88,030	39
Pattipolla	86,793	39
Carville	82,742	39
Mahatenne	81,255	39
Meddegodde	77,309	39
Raxawa	72,594	39
Girindi Ella	71,805	39
Dalukoya	70,339	39
Dangan	61,395	39
Mowbray	56,875	39
Findlater	56,432	39
Polgahakande	49,559	39
Haga	48,910	39
Wattumulla	44,777	39
Old Haloya	44,383	39
*Ury	32,505	39
Tangakelle	30,108	39
*Bogawantalawa	26,738	39
Galenne	26,058	39
Lochnagar	23,426	39

Estate.	lb.	av
Ambagasdowe	20,625	39
*Delmar	18,700	39
*Newmarket	18,589	39
*Fordyce	17,350	39
Dimbuldanda	14,924	39
*Aldie	14,635	39
Rothes	14,316	39
Upper Haloya	14,245	39
*Agrakande	12,730	39
*Udaveria	11,734	39
*Yoxford	11,050	39
*Gorthie	9,500	39
Vogan	525,870	38
Yahalatenne	401,208	38
Neuchâtel	352,670	38
Nakiadeniya	318,816	38
Neboda	316,876	38
Pallegodde	301,295	38
Harangalla	269,391	38
Warakamure	259,820	38
Geragama	241,461	38
Pansalatenne	226,978	38
Waitalawa	219,244	38
Agra Oya	179,666	38
Kandaloya	168,120	38
Laxapanagalla	166,115	38
Owilikande	163,071	38
Delta	161,278	38
Mousa Eliya	154,385	38
Kellie	140,485	38
Tunisgalla	134,557	38
St. Heliers	126,906	38
Walpita	122,110	38
Deemaya	116,993	38
Matale	116,544	38
Erin	104,882	38
Igalkande	104,099	38
Kehlgama	94,407	38
Ingiriya	93,690	38
Glen Esk	89,690	38
Ballywatte	77,595	38
Demoderawatte	76,265	38
Wella	75,596	38
Nellicollaywatte	70,029	38
Shannon	67,012	38
Theberton	59,817	38
Stubton	59,736	38
Ormondale	56,087	38
Craigingilt	52,305	38
* New Peacock	45,880	38
* Pingarawa	42,440	38
Kempitiya	41,107	38
Adawatte	40,285	38
Walaboda	34,210	38
Wyamita	26,090	38
Dalhousie	23,150	38
Harrisland	20,256	38
Pembroke	19,648	38
* Gonomatava	15,717	38
*Lynsted	15,504	38
Footprint Group	12,280	38
Mahaganga	8,230	38
*Pita Ratmalie	7,164	38
*Lugaloya	6,005	38
*Ulatenne	2,612	38
Muendeniya	369,774	37

Estate.	lb.	av.
Knavesmire	331,616	37
Tembiligalla	285,271	37
Clyde	257,862	37
Torwood	182,620	37
Gona	182,144	37
Glendon	180,915	37
Perth	180,335	37
Dumbugoda	169,575	37
Nahalma	169,385	37
K. P. W.	166,583	37
Deniyaya	163,751	37
Cooroondeowatte	159,885	37
Wallawa	154,470	37
Higham	146,298	37
Glencorse	143,305	37
Galata	141,617	37
Ingrogalla	128,240	37
Yellangowry	126,911	37
Kitulgalla	126,426	37
King's Grange	122,916	37
Nugagalla	118,530	37
Medenham	115,198	37
Ferndale	113,594	37
Farnham	108,295	37
Hathmatte	106,999	37
Andiatenne	106,403	37
Tavalamtenne	106,118	37
Longville	104,732	37
Lonach	104,537	37
Sapumalkande	87,451	37
Kobbekaduwa	84,998	37
Munangalla	84,960	37
Nugahena	82,802	37
Labugama	74,867	37
Elchico	73,189	37
Beauséjour	73,120	37
Ninfield	70,271	37
Parambe	68,094	37
Karagahatenne	63,990	37
Nassena	62,253	37
*Nikakotua	59,350	37
Glenalmond	53,784	37
Aludeniya	51,507	37
St. Aubins	46,106	37
*Abergeldie	43,450	37
Gadadessa	43,364	37
Carney	42,055	37
Tamaravelley	38,955	37
Richmond Hill	37,513	37
Moorland	37,087	37
Mousaella	34,507	37
*Kehelwatte	33,921	37
*Kandahena	31,538	37
Wiharagama	29,345	37
Anniewatte	28,810	37
*Berragalla	24,220	37
*Ardenlee	21,986	37
*Lindoola	19,819	37
St. Ives	11,056	37
*Maha Oya	8,260	37
Morantenne	7,703	37
Nikawella	5,090	37
*Derryclare	1,600	37
Avisawella	230,688	36
Erracht	216,338	36
Maldeniya	198,690	36

Estate.	b.	av.
Ruanwella	195,432	36
Clunes	194,085	36
Pindenioya	190,371	36
Puspone	179,849	36
Citrus	166,629	36
Beverley	163,145	36
Stonyhurst	145,468	36
Silva Land	143,602	36
Porapass	136,149	36
Jack Tree Hill	118,798	36
*Culloden	82,070	36
Andangodde	81,526	36
Atherton	79,930	36
Irex	79,807	36
Monrovia	79,245	36
Rosemont	68,753	36
Kehelwatta and Bodawa	65,869	36
Kurulugalla	65,812	36
Oonankande	61,707	36
Murray-thwaite	59,115	36
Aranayaka	58,960	36
Parusella	58,420	36
Talawitiya	57,635	36
Doone Vale	55,283	36
Dambagalla	48,980	36
Katugastota	46,764	36
Dullawe	42,530	36
Looloowatte	41,715	36
Paniyakande	40,950	36
Ashbourne	37,438	36
Moragalla	37,220	36
St. Martins	36,200	36
Markville	31,652	36
*Kintyre	30,771	36
Charlie Hill	30,265	36
Kannatota	30,217	36
*Ellamulle	28,296	36
Mahalla	27,645	36
Heatherton	27,497	36
*Sanquhar	26,609	36
Headington	26,360	36
*El Teb	23,905	36
Lowmont	22,313	36
Maryland	20,964	36
Moragalla Group	19,451	36
K R C D	17,466	36
Danawkande	16,196	36
*Dotala	15,635	36
Ukheena	15,205	36
Pilamatalawa	13,283	36
Maligatenne	10,440	36
Balgownie	10,095	36
*Yuilletield	9,508	36
*Kelburne	9,175	36
Bambragalla	8,341	36
Woodside	4,572	36
*Badulla Factory	4,410	36
Mahawale	463,875	35
Ganapalla	319,239	35
Shrubs Hill	253,861	35
Kiriporuwa	210,590	35
Millewa	198,405	35
Yahalakelle	174,560	35
Good Hope	168,793	35
Mount Temple	164,206	35

*** Denotes Incomplete Invoices.**

Estate	lb.	av.
New Angamana	156,651	35
Laurawatte	153,236	35
Elfindale	136,980	35
Embilia Oya	130,113	35
Kituldeniya	129,398	35
Hegalla	124,960	35
Oxford	114,663	35
Goolshane Ally	112,732	35
Wallahanduwa	107,220	35
Bridstowe	106,622	35
Allingford	102,388	35
Ferriby	95,521	35
Morton	77,719	35
Nirwana	74,308	35
*Suduganga	69,523	35
Kalugama	68,641	35
Ankande	66,310	35
Olympus	64,816	35
Windworthy	60,417	35
Yatadola	56,711,	35
Ratganga	53,720	35
Dodantella	52,054	35
Lantern Hill	49,007	35
Wavendon	40,597	35
*Lorne	40,231	35
Hill Side	39,634	35
Moredukande	34,691	35
Illukwatte	28,910	35
*Mariawatte	28,444	35
*Chapelton	27,894	35
Hapugahalande	26,980	35
Horagalla	23,965	35
*Edward Hill	23,411	35
Nallapitiya	22,729	35
Barrington	22,240	35
*Darrawella	19,620	35
Labuduwa	19,520	35
Tellisford	18,146	35
Ettapolla	16,884	35
*Telbedde	14,646	35
Awliscombo	14,575	35
*Laxapana	10,395	35
Berry Hill	9,987	35
*Lindupatna	9,500	35
*Bellwood	8,462	35
Mahawelle	8,210	35
Amupitiya	7,896	35
Buttukande	5,987	35
*Galkandewatte	5,950	35
*Glen Alpin	5,225	35
*Belton	1,848	35
*Elston	281,015	34
Eila	235,882	34
Semi Dale	184,466	34
Palmgarden	143,645	34
Narangoda	127,667	34
Salawe	114,430	34
Bellongalla	113,711	34
Alpha	94,611	34
K.A.M.C.	91,914	34
Fred's Ruhe	73,190	34
Ambalawa	69,476	34
*Ederapolla	63,836	34
Vicartons	54,575	34
Torrington	51,548	34

ESTATE	lb.	Av.
*Strathdon	48,674	34
Purana	46,834	34
*Knuckles Group	44,220	34
*Augusta	40,457	34
Uddapolla	30,969	34
Hyde	24,955	34
Kuruwita	23,528	34
Andagalla	20,528	34
Talduwa	14,733	34
Maskeloya	13,337	34
*Alton	9,014	34
*Blair Avon	7,830	34
*Napier	7,338	34
*St. Leys	6,843	34
Hanaskande	5,424	34
Kelani	257,264	33
Sidmouth	210,290	33
Sirikandura	110,481	33
Eadella	86,167	33
Mousakande	82,635	33
Oakfield	77,464	33
Lyndhurst	66,837	33
Taprobana	66,529	33
Bowella	53,647	33
Dickmukalana	53,570	33
Kotagalaoya	53,084	33
Velleruna	48,667	33
*Kalupane	47,850	33
Mentmore	46,575	33
Halbarawa	39,987	33
Kalupahana	39,424	33
Dover	37,341	33
Hatdowa	33,805	33
Storefield	27,180	33
*Watawella	24,216	33
Pasalai	23,166	33
Pondappe	19,965	33
Kudaganga	18,784	33
Patulpane	18,182	33
Blarney	18,015	33
Tokatiamulle	17,127	33
Gabbela	14,795	33
Gyantse Valley	12,539	33
Atherland	10,437	33
Huluganga	10,265	33
Horagaskelle	7,329	33
Kahatagalla	6,467	33
*Delpotonoya	5,655	33
Ullundupitiya	4,489	33
*Thotulagalla	4,436	33
Mahanilla	4,214	33
Meepillawa	4,187	33
*Avoca	3,886	33
Peak Shadow	2,062	33
Siriniwasa	131,069	32
Damblagolla	59,157	32
*Nillomally	50,715	32
Ellawalla	50,410	32
Wewewatte	49,434	32
*Trafalgar	48,385	32
*Algooltenne	44,647	32
Burnley	37,330	32
*Patchakadu	35,759	32
Bloompark	26,051	32
St. Charles	24,861	32
Kinrara	15,765	32
*Edward Hill	14,399	32
Mahagoda	13,571	32

ESTATE.	lb.	av.
California	13,426	32
Vendoola	12,937	32
*Marakona	8,690	32
*Kelvin	6,855	32
*Hunasgeria	6,340	32
Gamrie	5,954	32
Peakside	5,189	32
Dekande	4,687	32
*Radella	3,890	32
*Norton	2,669	32
Wewelkande	2,594	32
Ashdale	2,005	32
Teligalakande	1,371	32
Balantota	193,556	31
Silverton	66,201	31
*Hopewell	55,210	31
Sindamally	52,067	31
Depedene	50,770	31
Bogawanga	47,467	31
*Loolecondera	41,372	31
Noorani	36,180	31
Wattagalla	31,844	31
Horamulle	29,125	31
Narangalla	26,100	31
Orwell	25,971	31
Candawatte	20,236	31
Sherwood	18,917	31
*Kalduria	17,765	31
Bencon	16,666	31
Trewardena	15,476	31
Atuvawatte	14,085	31
Orangefield	11,853	31
Panvillekande	11,846	31
*Gonavy	9,937	31
Katooloya	9,079	31
Sudangedera	8,917	31
Uragalla	8,506	31
*Rutland	5,290	31
Acrawatte	5,109	31
*Welkandala	3,030	31
*Ledgerwatte	2,778	31
Poilakande	313,545	30
Welikande	132,945	30
*Balado	89,639	30
*New Rasagalla	50,145	30
Agars Land	42,603	30
Lebanon Group	32,214	30
*Hatale	28,050	30
Selvawatte	23,460	30
Berulgodella	18,812	30
Kanuketiya	17,652	30
Sadamulla	17,076	30
*Norfolk	14,080	30
Horagoda	12,423	30
Lower Kanauke	10,509	30
Rosebank	10,445	30
*Galaha	7,530	30
*Pendle	6,600	30
Alutkelle	4,055	30
*Wahagapitiya	3,640	30
*Ukuwella	3,285	30
Makuluwa	2,768	30
Romania	65.045	29
Oaklands	60,820	29
Gatagahawala	58,652	29
*Meddakande	58,650	29

ESTATE.	lb.	av.
Carlina	43,180	29
*Alver	38,925	29
*Mipitiakande	37,360	29
Madala	31,446	29
Yatiyana	28,703	29
*Rugby	28,699	29
Karawakettia	26,703	29
*Dangkande	16,574	29
Hoolangaha	15,175	29
Eilandhu	13,155	29
Wepalla	5,561	29
Godakalewatte	5,110	29
*Digalla	4,454	29
St. Lazarus	3,601	29
Unugaswella	3,400	29
Dickpitakande	3,025	29
*Havilland	2,560	29
*Alma	1,690	29
*Galatura	56,281	28
*Dehiowita	41,173	28
*Atgalla	32,198	28
*Gonnamadie	28,831	28
*Glassel	27,734	28
Primston	24,125	28
Katukurundugoda	19,686	28
*Relugas	14,151	28
Ossington	14,144	28
*St. Andrews	12,540	28
Mousa Watte	9,342	28
*Lyndale	8,434	28
Charley Mour	7,201	28
Kalpelly	6,840	28
Atholuwa	4,475	28
Zion Hill	3,835	28
Easton	3,004	28
*Hapugastenne	92,219	27
*Sunnycroft	55,408	27
Florida	50,256	27
*Kabaragalla	28,185	27
*Maddagedera	17,276	27
*Kadienlena	16,120	27
*Pantiya	5,565	27
*Koskellie	2,128	27
*Abbotsford	1,784	27
Hapugasmulle	1,370	27
*Chesterford	60,065	26
*Ingoya	21,944	26
*Springwood	17,698	26
*Sinnapittia	15,242	26
*Poongalla	11,831	26
*Allakolla	11,195	26
Patiagama	8,086	26
*Woodend	3,400	26
Sadoo	3,247	26
*Galgawatte	2,980	26
*Halgolle	38,302	25
*Penylan	22,100	25
*Taraweera	19,440	25
North Vale	14,429	25
*Hoolankande	13,085	25
*Lauderdale	12,555	25
*Mudamana	11,445	25
*Warwick	11,137	25
*Arslena	10,258	25
*Gangwarily	8,130	25
*Sorana	1,809	25
Ellatenne	744	25

* Denotes Incomplete Invoices.

Estate.	lb.	Av.	Estate	lb.	Av.
Moragahanga	36,178	24	*Edmonton	9,280	21
*Hill End	13,233	24	*Mellagolla	4,470	21
Fairfield	12,826	24	Lenabatuwa	4,009	21
*Asgeriya	11,150	24	*Southwark	2,170	21
Samsing	10,785	24	*Glenalla	1,275	21
*Ramsgill	7,730	24	*Dunedin	12,033	20
*Alpiakande	7,589	24	*Deeside	658	20
*Okoowatte	6,990	24	*Galoya	916	19
*Halwatura	14,762	23	*Meeriabedde	1,600	18
*St. Helens	9,732	23	*Nona Totam	3,732	17
*Iscadu	9,336	23	*Weyweltalawa	3,116	16
*Craighead	7,379	23	*New Pera-deniya	4,638	14
*Troy	7,114	23	*Villa	264	14
*Bukanda	4,265	23	*Manangoda	3,894	13
*Amunatenne	1,939	23	*Wootton	656	13
*Westhall	5,550	22	*Blackwater	561	13
*Rangbodde	3,825	22	*Holmsdale	1,540	12
*Talawakelle	1,803	22	*Moolgama	285	11
*Tebuwana	320	22			

INDIAN TEA.

Hallashana	17,948	53	*Peeren-godde	106,876	32
Vagavurrai	90,049	46	*Vembenaad	35,632	32
Kanniamalay	547,671	45	Kolam	31,179	32
Madupatty	336,989	45	*Stagbrook	21,054	32
Devicolam	231.045	45	*Ashley	6,770	32
Thia Shola	23,656	45	*Prospect	60,635	31
Sothupari	335,630	44	Invercauld	40,726	30
Chittavurrai	146,948	44	*Arrapetta	9,470	30
Rob Roy	4,722	42	*Poothacoolie	585	30
Glen Morgan	50,697	41	*Cherambody	27,788	29
Mount Gordon	8,026	41	*Pootoomulla	23,126	29
*Nullatanni	127,810	40	*Erramaculla	5,200	29
*Periavurrai	109,625	40	*Elstone	1,560	28
*Yellapatty	33,866	40	*Stanmore	15,117	26
Lockhart	168,678	39	*Isfield	5,021	26
Terrace	8,220	39	*Ranee Coil	8,517	25
Surianalle	465,624	38	*Pambanar	3,440	25
*Kalaar	36,146	38	*Wentworth	14,579	24
*Sevenmally	116,408	37	*Koliekanam	8,127	24
*Letchmi	62,844	37	*Bonaccord	5,040	23
*Munaar	124,203	36	*Braemore	2,430	09
*Chokanad	7,062	36			
Poonmudie	10,305	33			

GREEN TEA.

Balanaga	110,041	43	Vincit	56,162	37
Piccadilly	38,131	40	Avington	68,884	33
Greenfields	35,084	40	Udabage	177,770	31
St. Leonard's on Sea	11,971	40	*Kirriwana	53,390	27
Cocoawatte	63,650	39	*Ambalamana	1,560	21
Ooloowatte	58,918	39	*Dewalakande	29,730	17
Meeragollie	55,530	39	*Rayigam	34,280	16
Mapitigama	63,971	37	*Madampe	8,792	15

INDIAN TEA ASSOCIATION.

(*Extracts from the Reports of the General Committee for 1909.*)

Scientific Department.—Two lines of chemical investigation were speciaar, taken up by the department during the year, the first of these being an

ENQUIRY INTO THE PART PLAYED BY EXTERNAL CONDITIONS

such as temperature, rainfall, soil moisture, manures, &c. in determining quality in leaf, as measured by the amount of dry matter, total soluble matter, tannin, essential oil, &c., in the fresh leaf. As separate manufacture of the leaf from each experimental plot is not, under present conditions at Heeleaka, practicable, this line of experiment forms the closest approximation that can meantime be made towards determining the comparative qualities of the leaf from the different plots. The second of the investigations referred to was in condition of experiments made by Dr. Mann in connection with the manufacture of tea; and in this connection the Association are indebted to Mr B R S Pritchard, of the Tyroon Tea Company, who kindly gave facilities for the conduct of the experiments in his factory. It was considered desirable to confine the experiments to a particular branch of manufacture and attention was therefore given to a study of the influence of the process of firing on the amount of essential oil in the leaf, assuming that essential to be the chief factor, in the production of flavour. It is proposed to publish in a single pamphlet the results of these two enquiries.

In the Entomological Department much attention has, as in former years, been devoted to the consideration of a remedy for

MOSQUITO BLIGHT.

Experiments in this connection were continued in the neighbourhood of the entomological station at Kanny Koori, Mr Antram's scheme of spraying being carried out under his supervision on a number of gardens in that district. At the time of writing it is impossible to sum up results of the experiments, but the Committee hope that when available these will be found to prove the value of the soap solution recommended. Mr Antram has compiled a report containing full information as to the results of the season's experiments and this will be issued in due course. Other matters that have been studied in this department have been the Darjeeling Thrips Blight, the Mantis Insect (in regard to which a leaflet with illustrations was issued for general information) the Looper Caterpillar, &c.

PLANTING IN PAPUA.

Notes from Mr. Wallace Westland.

We are permitted to quote the following from a letter of Mr. Wallace Westland, to a friend in Ceylon, received by latest mail, of date 15th October :—

Sisal Hemp.—We are planting sisal hemp largely, and in a year or so we will have about 300 acres fully planted. Some of our plants are now ready for cutting—planted May, 1908. So that growth is bettor here than it is in other parts one hears of.

Rubber—is growing strong—*vide* photos in the *Australasian* of August 8th, but weeds grow amazingly, much quicker than anything you see in Ceylon.

Cacao—has proved an almost complete pest. We have had a number of experiments; not a plant is growing to show something for our money.

Mr. Wickham—is now here near us—about 350 miles away. I hear he is to open in a new way—cut lines through the forest, in which he will plant his trees 33 ft. by 33 ft. As it is an absolutely unknown method to me and most other rubber planters, I am curious to see the result,

* Denotes Incomplete Invoices.

THE GERMAN METHOD OF MANUFACTURING CACAO BUTTER.

By Robert P. Skinner, United States Consul-General at Hamburg.

An inquirer who contemplates the establishment of a cacao butter manufacturing plant in Michigan wrongly inferred from a report forwarded from Hamburg on March 19th, 1909, that there was no cacao manufacturing industry in the United States. As a matter of fact, this industry has increased in importance in America by leaps and bounds during the last ten years, and in the report referred to it was merely stated as economically extraordinary that large quantities of imported cacao butter should still find a market in the United States. In 1880 there were seven firms manufacturing cacao products in the United States, and this number had increased to twenty-four in 1900. I have now before me a private list of 109 firms manufacturing chocolate, and, without doubt, a number of them are also producing cacao butter. The importations of cacao into the United States in 1902 were 56,744,545 pounds, and they increased regularly year by year, the total reaching 97,419,700 in 1908. Remarkable as is this increase, it must be remembered that the exportations of raw cacao from the producing markets amount to 260,000,000 pounds per annum and that America is still regarded as a fertile field for European manufacturers to cultivate. It seems fairly certain that the annual consumption of cacao products in the United States will continue to increase, as a tendency in this direction is noted throughout the world.

From being objects of occasional consumption cacao beverages are now competing actively with tea and coffee, and whereas the latter are merely infusions, without nutritive value, cacao contains nitrogenous and oleaginous elements, all of which form a part of the bevorage and give it

AN IMPORTANT FOOD VALUE.

All of our insular possessions are cacao growing countries, and the product, characteristically American, is obtaining, as is its due, a more and more important place in national dietetics. Although chocolate and "cocoa" as table beverages, and chocolate bon-bons of thousands of descriptions are popular in the United States, the consumption of the dry cako cacao as food is almost unknown. In Europe, on the other hand, and particularly in France, the consumption of cake cacao as an ordinary and palatable food is quite common. Probably nine-tenths of the school children of France leave their homes in the morning with a slice of bread and a bit of chocolate, which they eat together at lunch time with entirely satisfactory results.

The three cacao products known to commerce are : cacao butter, cacao powder and cake chocolate, the manufacture of chocolate requiring skill and knowledge in special degree. The butter is merely the oil or grease of the kernel, usually extracted by pressure and leaving a residue still containing a certain amount of vegetable fat, which, being ground, as will be explained later, is used in making the beverage commonly known as cocoa. When chocolate is intended to be produced, the carefully cleaned kernels are crushed into a mass, flavoured and manipulated according to many methods and then, after an addition of pure cacao butter has been made to the natural content of the mass, it is pressed into small cakes and thus sold.

The cacao bean is composed in weight of 88 per cent of kernel and husk and 12 per cent of shell. The shells and husks are treated chemically in Holland for the production of a low-grade butter, the reduction being effected by means of ether or benzine. The kernel, which contains from 50 to 55 per cent of oil, was formerly treated, when the extraction of butter was contemplated, by boiling, roasting and crushing in ten times its weight in water ; the oil then rising to the surface was decanted and the residue pressed mechanically for the elimination of such butter as it still contained. This method has been abandoned and the kornels, freed from their envelopes, are now ground to a mass, brought to a temporature of from 60 to 70 degrees Centigrade, placed in coarse linen sacks and finally pressed in steam-heated machines. After this first application of pressure

THE CACAO CAKE

contains from 20 to 35 per cent of fat ; it is then ground and repressed until not more than 15 per cent of the fatty matter remains. Tho oil, or grease, which has been extracted is called cacao butter and is used chiefly by chocolate manufacturers, as heretofore explained, in smaller quantities, in the soap, perfumery and pharmaceutical industries in which, owing to its neutral qualities, it is especially valuable.

Fresh cacao butter is yellowish white, but if exposed to light becomes entirely white, and possesses a mild odour of the cacao and a sweet agreeable taste. Both taste and odour are eliminated by boiling the fat with absolute alcohol, and in this condition it keeps a long time without becoming rancid. It is firm in consistency and melts at from 32 to 35 degrees Centigrade according to quality. Its density varies from 0.890 to 0.900 at 15 degrees Centigrade. It is very soluble in ether, acetic ether, chloroform and essence of turpentine. It is sometimes falsified with a mixture of stearine, paraffin and beef fat. If it is mixed with fatty oils it melts at a temperature of less than 25 degrees, and if it is mixed with paraffin and beef fat it melts at a temperature in excess of 35 degrees. If pure, the point of fusion should not be less than 25 degrees nor more than 30 degrees centrigrade.

The butter having now been withdrawn from the mass there remains

AN OILY CAKE, WHICH IS GROUND INTO FINE POWDER AND COMMANDS A VERY WIDE SALE.

The powder is usually prepared according to the Dutch method by the addition of a solution of chemically pure potash. Less frequently soda is used instead, or perhaps a solution of carbonate of ammonium. In ordinary practice the raw beans with their shell might be expected to yield from 40 to 45 per cent of their weight in butter and 30 per cent of cacao powder,

A great many ma hines are on the market for the manufacture of cacao products, and every manufacturer has some more or less personal process, as the industry is still in a state of development.

A German plant, with machinery of the latest description and a capacity of 2,200 pounds daily of dry cacao powder, would require the following investment :—

1	A cleaning and winnowing machine for breaking the beans and eliminating the skin 1 H.P.	dol. 357.00	dol.
	Belting	4.76	
	Receiving pan	11.90	373.66
2	Roasting machines, two in number, with drums each of a capacity of 880 lb., 2 H.P.	404.60	404.60
3	Crushing and cleaning machine, 2 H.P.	583.10	
	Belting	14.28	
	Receiving pan	11.90	
	Connecting gearing	47.60	656·88
4	Separating machine for removing germs with three movable sieves and two iron pans, outpnt about 165 lb. per hour, 3 H.P.	134.47	134.47
5	Four triple roller mills, 5 H.P., each dol. 785.40	3,141.60	
	Agitating apparatus pulleys	7.14	3,148,74
6	Three hydrostatic presses for extracting the butter, each dol. 833	2,499·00	2,499.09
7	Accumulator with automatic pumping apparatus for the three presses—		
	Accumulator	261.80	
	Pumping apparatus	124.95	386.75
	Automatic pulverizer for the cacao cake, consisting of one crushing machine, one Pulverizer and one sifting machine, about 6 H.P.; price of the complete machine	1,487.50	1,487.50

The total equipment wlll require about twenty horse-power, and will cost, erected and ready for operation, from dol. 8,806 to dol. 9.520.—*New York Oil Reporter*, Dec. 27.

TOBACCO IN RHODESIA.

It is somewhat surprising that of the large quantities of tobacco consumed annually in Great Britain that more is not imported from British possessions (a few years ago it was only 0·8 per cent. per annum.) It is of paramount importance to the prosperity of agriculture in a colony situated far inland as Rhodesia is that an export trade should be developed in some form or other, and tobacco is essentially suited as being a produce that will stand the cost of froight well. It has been shown that the climate, the land, and the labour supply are all satisfactory, and well-directed energy alone is needed in addition to make the proposition a certainty. A general tendency towards producing a uniform quality of pipe and cigarette leaf is now much in evidence on the farms, so that time for the maturing of the leaf in the warehouses and the organising of a regular market is all that is required to establish this new industry in one of the youngest of our colonies.

During the last six years an increasing amount of attention has been devoted to tobacco growing and the experimental stages can now safely be said to be to a great extent passed, so far as the country south of the Zambesi River is concerned. A serious effort has been made by the Rhodesian farmers to produce a superior type of tobacco to that which is generally known as South African, or Boer tobacco. Seed has been imported by the Government and by private enterprise from all the renowned tobacco-growing districts in the various tobacco countries of the world, and careful seed selection is now practised by the farmers. Experts have been procured from America to give advice and generally assist the farmers who grow Virginian tobaccos, while expert growers and curers of the Turkish leaf have been procured from Bulgaria, and are let out to farmers at stated salaries by the Government. Great care is necessary in

THE SELECTION OF THE SOILS,

which vary to a very great extent in Rhodesia. Results have shown that on many farms the best tobacco lands are on areas considered not good enough for maize (the staple crop of the country) and other cereals. The rich vegetable loams found in the valleys and flats are generally used for these, but the land for tobacco is found in well-drained sandy lands, generally situated higher in the granite or diorite formations. As is the case with all crops yet grown in Rhodesia, it is very seldom that any artificial manure is used, the difficulty, indeed, being to find a soil that is not too rich. Many of the farmers (most of whom come direct from Great Britain) have had no previous experience in the growing of this crop, and consequently make a great many mistakes in the first years. Plantations are sometimes started in rich lands, and crops of tobacco are produced with leaves as thick as cabbage leaves, and almost as dark a green, which when manufactured are so strong as to be quite unsmokable. The ideal leaf should be light in colour and texture, and can only be produced on light soils. Fields fifty acres in extent can now be seen on some of the progressive farms of the finest Virginian leaf—a beautiful sight when, just at the ripening stage, it is of a bright golden green.

September and October are the months when

THE SEED BEDS

are started so as to have plants ready for the land at the time of the arrival of the rains in December. Planting is done by hand, and the native labourers are at their best at work of this kind, the only difficulty being in keeping the rows straight, which is done either by employing lines or by making shallow furrows with a cultivator beforehand. With a crowd of niggers properly in hand it is surprising how quickly the field is planted. By far the best way to get them to work well is by precept. The man with an even temper, and who works hard himself, will seldom have any difficulty in obtaining a good return for his money from these people. One white man can easily supervise a hundred natives.

After a field is planted, if good weather is experienced—that is, if the rains are continued sufficiently to keep the land moist till the young plants obtain root hold—there will generally be very few gaps in the rows to fill up from the seed beds. During the next few months

WEEDING IS PRACTISED CONTINUALLY,

and when the plants reach a certain height they are topped, and in March picking and curing commences, which means an exceedingly busy time for all concerned.

In the early days of the industry failures in curing often resulted, which was due to lack of experience and proper convenience, but now well-built brick barns are a feature of many homesteads. In these curing on scientific lines is carried out, and a more saleable article produced.

Virginian is the chief tobacco grown, though many of the farmers have produced fine samples of Turkish leaf, which has been reported upon favourably by many experts in the trade. The chief obstacles to success up to the present timo have been the youth of the country, the inexperience of many growers and curers, lack of uniformity in the leaf that has been placed on the market, and the consequent uncertainty of the supply meeting the demand. But, although there has certainly been a distinct check in progress felt during the last two years, there can, however, be no doubt as to the future. Tobacco grows wild wherever it gains root. A small-leaved variety has been cultivated by the natives for many years, and since the advent of the white man crops of the best quality have been produced repeatedly by many farmers in various parts of the country. The

GOVERNMENT DEPARTMENT OF AGRICULTURE ARE FOSTERING THE INDUSTRY

in all ways in their power, both in producing and marketing the crops. At the present time most of the farmers make their tobacco pay, and some are, in fact, doing so well out of the local market that they are leaving other crops alone. But a tobacco must be produced which will have a distinctive character of its own, and will be widely known and appreciated as "Rhodesian." Turkish tobacco grown for any length of time in Rhodesia changes somewhat in character and acquires special qualities. And so it is with all tobaccos; the climate and the soils have their local influence, and produce a local quality in the aroma and flavour. C. E. F. ALLEN.

—*The Field*, January 1.

BRAZIL-NUTS.

The Brazil-nuts (*Bertholletia excelsa*) was introduced into the Singapore Botanic Gardens in the year 1881, September 20th, from the Royal Gardens, Kew. Only two plants were sent, and both are still in the Botanic Gardens, Singapore. They must first have been kept in the Upper Gardens, as the Economic Gardens were not then established, but when Mr. Cantley obtained what was then known as the military reserve in 1884, the plants were transferred there with many other plants of economic interest, including the Para rubber trees. The trees grew steadily on a clay bank near what is now the clerks' quarters, and flowered about 1901 for the first time. The first fruits were produced in 1902, and since then the trees have provided a quantity of fruit steadily each year.

THE CROP THIS YEAR HAS BEEN MUCH LARGER

than in any previous year, and there were over a hundred of the large woody capsules on the biggest tree. The biggest tree measures 65 feet tall, with a head of foliage 30 feet through; the girth at 3 feet from the ground is 5 feet 5½ inches. The smaller tree measures 63 feet, with a breadth of foliage of 27 feet and a girth of 2 feet 7 inches at 3 feet from the ground.

The leaves are oblong and wavy smooth, rather firm in texture, dull dark green, paler on the back, about 12-16 inches long and 4 inches wide. The flower spikes stand erect on the top of the branches and are 2 feet long, a quarter of an inch thick, green and bearing many flowers which open one by one. They are sessile and creamy white, yellower on the back and of a very curious structure, the stamens being collected into a curious dense mass in the form of a bearded lip. The fruit takes upwards of a year to ripen, and by no means do all on the spike ripen. Indeed, this would be impossible as the

WEIGHT OF THE FRUIT FALL WOULD BREAK THE INFLORESCENCE

even if it did net break the bough bearing the spikes. The biggest of the trees produced this year a hundred and eight fruits; the smaller one, which grows only within a few feet of the other, bore only a few fruits. The fruits are round and woody and brown in colour, about 6 inches through. They weigh about 2 lbs. 7 oz. and each contains from 12 to 15 nuts, which weighs altogether 9½ oz., each nut when peeled weighing half an ounce. The nuts are beautifully packed in the capsule and quite fill it. When it is ripe the fruit falls to the ground while in this differing from the allied Sapucaia nut (*Lecythis oleracea*) also in the Botanic Gardens, in which the top forms a lid which becomes detached and lets the seeds fall out. On account of this the Brazil-nut is cheaper in the markets than the Sapucaia nut, as the natives find it quicker to pick up the whole fruit of the Brazil-nut than tho scattered seeds of the Sapucaia. The seeds from the trees in the Botanic Gardens have as yet

FAILED TO GERMINATE,

possibly our fruit falls before it is quite ripe, but they have been highly appreciated by those who have eaten them. The kernel is crisp and firm, and has not the oily taste of the Brazil nut of commerce. The Brazil-nut tree is not cultivated anywhere for profit. The fruits are collected by the natives in the forests of the Amazons, where it grows in abundance, together forming groves, according to Bates ("Naturalist on the Amazons.") He says it is ono of the biggest trees in the Amazons forests, and as the forest trees there often attain the height of 150 to 200 feet, it is probable that the Brazil-nut grows to at least 200 feet. The trees of *Lecythis*, which I saw in the forests of Pernambuco, were truly gigantic, both in size and in circumference, and it is said that Bertholletia is as big. The Brazil-nut is not a tree which would bring a large profit to a planter, even of fruit trees, as its growth is slow and the fruiting not very heavy, considering the cheapness of the nuts brought from the Brazilian forests, but it is a handsome tree, and when it does fruit it does so quite heavily enough to supply the needs of the planter and many others.—H. N. RIDLEY.

—*Straits Agricultural Bulletin*, for December.

DEMONSTRATION IN SUGAR-MAKING.

Bangalore, Feb. 8.—With a view to instructing the Indian manufacturers of sugar in this Province, Dr Coleman, the Mycologist and Entomologist of the Government and acting Agricultural Chemist, arranged to give a demonstration on the subject of sugar-making at the Government-Agricultural Farm at Hebbal. The demonstration commenced yesterday morning and there was a large gathering of those interested in the development of the sugar-making industry to witness the experiments.

The common practice prevailing at present is to express the juice from the sugar-cane in one of the old-fashioned mills by which, in the first place, there is a considerable waste of the material. Care is not taken to see that the juice is properly limed to neutralise the acid in the juice and then the process of boiling the juice, and converting it into jaggery is very antiquated. The method usually adopted is to boil down the juice in an iron pan of circular shape something like an inverted cone. By the use of such a pan the heat from the furnace is not evenly distributed to the contents of the pan and the methods by which the boiling liquid is "scummed" is most unsatisfactory, the result being that besides the waste in the process of manufacture, the quality of the jaggery turned out is very unsatisfactory and cannot compete with the imported sugars.

A brief description of the methods which it is proposed to teach sugar manufacturers to improve the quality and outturn of their sugar will probably be of interest. In the first place it is Dr. Coleman's idea that the people should be shown that what is necessary is that sugar-cane should be more largely grown in close proximity to the centre of manufacture, so that the sugar-cane may be treated in the mills within a very few hours of it being cut. This is to save the large waste that follows from driage and by fermentation setting in in the canes. The idea is that cane should be planted every 52 days and reaped at like intervals, so that there may be a regular supply of sugar-cane throughout the year. This is what has been done at the Farm and a constant supply of material is available. Having secured a steady and adequate supply of sugar-cane, reaping takes place at regular intervals and the canes are brought to the mills, which are chiefly known as the "Rickie" class, a machine working with horizontal rollers. A maximum of juice having been obtained from the canes, the following procedure is gone through :—The juice is first "limed," that is to say that sufficient lime is added to thoroughly neutralise the acid in the liquid, which is judged by the change of colour on introducing litmus paper. Bone charcoal filtration and treatment with sulphur is not resorted to. The next process is the boiling. To ensure that this is done properly and in a manner that will secure the best results, a new kind of apparatus is employed. This consists of three iron pans of cylindical shape which are connected each with the other by a pipe. Two of these are heated by a furnace and the third by means of the smoke that is made to pass from the two furnaces by means of flues under it, the heat caused thereby being sufficient to boil but not scorch the juice. The cane juice is first introduced into the first pan where it is boiled till it reaches a certain consistency, the scum as it rises on the surface being removed and passed into a bucket where it is filtered and the clear liquid returned to the pan. The first boiling being over, the juice is run into the second pan, again boiled to a certain consistency and again "scummed" when it finally reaches the third pan after which it is poured into vessels and allowed to crystalise as jaggery. The next process is the treatment of the jaggery in a centrifugal machine, driven by bullock power, and by this process is produced a very clean and marketable sugar as near as possible free from the smell or taste of molasses as a process short of refining can make it. If this method of making sugar on economical lines is taken up by the native grower there is every hope for the success of the industry in Mysore. Some years ago the Mysore Government had some idea of building a large sugar factory in a suitable centre, but the matter did not assume a definite shape and I understand that it is doubtful whether such a plan would now be considered within the range of the present Government's intentions.—*M. Mail.*

COPRA IN THE GOLD COAST.

The production of copra is an industry well suited to the taste of natives, yet it is one that does not appear to succeed on the Gold Coast. All along the Coast there is only a very small area devoted to coconut cultivation and that principally in the extreme east of the Eastern Province. Attempts have been made to develop this industry, but they do not appear to have met with much success. In 1902 the Government tried to establish a Coconut Plantation of about 300 acres in the vicinity of Accra, but this attempt has met with utter failure—only a few palms now remain and none of them look healthy. Although the atmosphere of the Coast, generally speaking, is humid, the rainfall is not excessive, and Accra is probably the driest part of the Coast, so the ill succes of the experiment may be partly accounted for by excessive drought, although beetle pests were also very destructive. In those countries where coconuts are extensively grown and the produce exported, they also form an important part of native diet, whereas on the Gold Coast the natives do not appear to indulge in them beyond quenching their thirst with the water contained in the green coconut. The fact, too, that a coconut tree takes so long in coming into bearing, even though it was proved to be a successful crop on the coast, militates against the rapid development of plantations among so independent and conservative a people. There is obviously money in the cultivation after it has become properly established, and as there would appear to be a considerable area alongside the rivers and certain parts of the sea coast suitable for this crop, I propose to make an attempt to establish a small plantation on the Agricultural Station at Assuantsi in the Central Province next year.—*Official Report for 1908*, by W S TUDHOPE, Director of Agriculture.

ECONOMIC PRODUCTS IN THE SEYCHELLES.

RECENT DEVELOPMENTS.

A copy of the annual report of the Curator of the Botanic Station and Crown lands in the Seychelles, for 1908, has been supplied to the Imperial Institute by the Colonial Office, and from it the following summary of the progress of agricultural and other work in these Islands has been prepared.

COCONUT INDUSTRY.

The total exports of coconut products, including nut, copra, coconut oil and soap, have grown steadily since 1905, but whereas the premier position in that year was taken by coconut oil, this product was replaced by copra as the principal export in 1907, and this was still maintained in 1908, though in this year the export of oil showed a considerable increase over that of the previous year. The reason for this is, that the production of copra is more remunerative than the manufacture of coconut oil. If this rearrangement of exports is carried too far, the Curator points out that the local soap industry may be in some danger of not obtaining a sufficient supply of coconut oil; but he is of opinion that the local demand for "poonac" (the residue left after expressing the oil from copra) as a feeding stuff for cattle and poultry, coupled with the utilisation of damaged "copra" for the manufacture of oil, will prove sufficient safeguards against local soap-makers being deprived of this raw material. Coconut palms suffer in the Seychelles, as elsewhere, from the attacks of insect pests and from fungoid diseases, and the difficulty in effectively coping with these is increased by the fact that many of the palms have been badly cultivated, owing to greater attention having been given to vanilla until recently. The two groups of pests occur in association, so that it is not always easy to decide which causes the initial damage. The chief insects affecting the palms are three species of beetle—*Melitomma insulare*, *Calandra stigmaticollis* and the Rhinoceros beetle (*Oryctes* sp.). The two former are boring insects and cause an outflow of sweet sap from the tissues they attack, and this then forms a breeding-ground for fungi of various kinds. It appears therefore to be of greatest importance to destroy the boring beetles, and the estate owners seem to be fully alive to the necessity of this. The "stem-bleeding disease," to the occurrence of which in Ceylon reference has been made already, is also found in Seychelles, where, as in Ceylon, it appears to have been in existence, almost disregarded, for many years.

VANILLA.

The crop of this spice in 1908 amounted to only 24·75 tons as against 66·5 tons in the previous year. The decline is due to the weakening of the plants after the heavy yield of the previous year. The best of the Seychelles vanilla is stated to be sold in France, where the market for the finer kinds is said to be better than in the United Kingdom. There is no improvement in the price of vanilla to be recorded, the competition with artificial vanillin being more severe than ever. Attempts are, however, being made to lower the cost of cultivation of vanilla, and with that end in view experiments in manuring, etc., have been in progress since 1905. These have shown that the application of ground limestone (coral) leads to production of more pods, no less than 26 per vine being obtained from each of two series of vines so treated in 1908. The use of nitrate of soda as a manure is advantageous, and tends to keep the plants producing pods over a longer period. Larger crops were obtained from plants grown in a mixture of fern roots and soil than with those planted in ordinary oil, this improvement being due apparently to the richness of the fern roots in lime. Shaded plants appear to do better than those freely exposed to the sun. Comparative analyses of the ash from two vines, one growth without manure and the other with the application of a "complete manure" (coral, sodium nitrate; guano and kainite), indicated that the most important manurial constituents for vanilla are lime, soda and phosphates; potash and magnesia being less important. The effect of each of these components is now being studied separately.

VOLATILE OILS.

This industry is also making progress; a new still of 1,000 litres capacity was started in West Mahè, and two more of like size will be erected this year. The climate of Seychelles appears to be well suited to the cultivation of plants yielding leaves used for distillation; thus the clove tree only fruits in the Islands once in three or four years, but produces an abundance of leaves which may be used for the distillation of clove-leaf oil. Similarly lemon grass in Seychelles gives twice as much oil as in Réunion, and the "ylang-ylang" tree flowers within a year after planting as against three years required in less humid climates.

It has been found more profitable to export cinnamon bark as such, than to distil oil from it in the Seychelles, but this may not be the case when the wild plants now used as a source of bark become exhausted and recourse must be had to cultivation. Reference has been made already to the "light" character of the cinnamon-bark oil so far produced in the Seychelles which accounts for the low price this article brings on the market. Experiments have been made locally to discover the cause of this, but no definite conclusions have been arrived at. At present most of the Seychelles cinnamon bark harvested, is taken from the stems of large wild trees and fetches low prices of 1d to 1½d or 2d per lb. Attempts have been made to produce "quills" of bark, after the plan adopted in Ceylon, and these have been sold in London at 4d to 6d per lb. This and other branches of the spice and volatile oil industry, the Curator thinks, might be encouraged as domestic industries for women and children. Cinnamon-leaf oil from the Seychelles, examined at the Imperial Institute, proved to be of fair quality and worth about 2d per ounce; but this price appears to be unremunerative to the distillers. Clove-leaf oil, on the other hand, of which a yield of 1 per cent. is obtained in practice, is likely to pay better. Seychelles clove-leaf oil, examined at the Imperial Institute, proved

to be of very good quality and worth 4s 4d. to 4s 6d. per lb. The clovetree grows well in the red "laterite" soil of the Seychelles, and it is recommended that it should be planted more extensively, 3 or 4 feet apart, in hedges for regular clipping of the mature leaves with shears.

Vetiver grass is recommended for cultivation on a large scale, and experiments are being made in the distillation of oil from the roots. Other plants at present under trial for the production of volatile oils are basil (*Ocimum basilicum*), cardamoms, *Viextrifolia*, Bigarado orange, ylang-ylang and camphor, and samples of oils from some of these have been received at the Imperial Institute for examination (this *Bulletin*, *loc. cit.*) and have given promising results.

RUBBER.

The report alludes to the examination at the Imperial Institute during the year, of three rubbers prepared from Para trees, under five years old. These gave the following percentage results calculated on the dry rubbers :—*

	No. 1.	No. 2.	No. 3.
Caoutchouc ..	93·9	94·1	93·6
Resin ..	2·8	2·3	3·1
Protein ..	2·1	2·3	3·1
Insoluble matter ..	1·2	1·3	0·2
Ash ..	0·1	0·3	0·1

Of these No. 1 was from trees of about 17 inches girth, grown at Praslin in marshy ground near the sea; No. 2, from trees 16 inches in girth, grown in "lateritic" soil on hillsides at 200 to 400 feet elevation, near Victoria; and No. 3, from trees of 14 inches girth, growing in the same type of soil at 1,000 feet elevation, near Cascade.

Tapping experiments have given more promising results than in former years: thus a group of 19 Para rubber trees from 4 to 6 years old, and measuring on the average 15 inches in circumference gave the following results in the course of 17 consecutive days' tapping:—

1st day	113 ccs.*	7th day	293 ccs.	13th day	340 ccs.
2nd ,,	153 ,,	8th ,,	287 ,,	14th ,,	342 ,,
3rd ,,	161 ,,	9th ,,	273 ,,	15th ,,	338 ,,
4th ,,	221 ,,	10th ,,	307 ,, †	16th ,,	381 ,,
5th ,,	216 ,,	11th ,,	290 ,,	17th ,,	429 ,, ‡
6th ,,	226 ,,	12th ,,	301 ,,		

* Equal to nearly 6 ccs. per tree. † Equal to 16 ccs. per tree. ‡ Equal to about 22 ccs. per tree.

After 46 days' tapping the best trees, Nos. 2 and 14 (of 19 inches girth) were still producing 37 and 36 ccs. of latex respectively per diem, whilst the smallest trees, Nos. 7, 8 and 19 (of 13 inches girth), were only giving 2 ccs. each. The conclusion is drawn that trees ought not to be tapped till they are 15 inches in girth at 3 feet from the ground. It is pointed out that in the course of 60 days' tapping, trees 19 inches in circumference gave 1 lb. of clean rubber, whilst the same quantity was only obtained from trees low 15 inches girth in 150 days. It is also men- n'ed that in using the double spiral system of apping not more than 2 inches width of bark per annum should be removed, and that consequently it is advisable not to tap trees much under 18 in. girth by this method. Trees of this size are, however, large enough to allow 60 days' tapping each year for 4 years before the whole bark is removed. This is sufficient time to permit of bark being renewed for subsequent tapping. A large number of measurements of Para rubber trees grown in various districts are also recorded. Allusion is made to the examination of Seychelles "Vahea" rubber at the Imperial Institute, of which details have been published already (this *Bulletin*, 1909, 7. 262). This rubber vine is being propagated in several parts of the Islands, but a large number of the young plants have been destroyed by "scale insects," though it thrives, in spite of these attacks, at high elevations, and when grown in friable soil alongside rivers. These insects also attack Para rubber trees, but in that case confine their attention to the leaves, whoreas they attack the leaves and young shoots and even the stems of Landolphia, Castilloa, and Funtumia species.

* These rubbers as received at the Imperial Institute contained an excessive amount of moisture, and though otherwise of satisfactory composition were defective in physical properties. This defect was due no doubt in part to their being collected from young trees, and in part to the large amounts of moisture they contained.

SUBSIDIARY INDUSTRIES.

THE MANUFACTURE OF BANANA FLOUR

is in abeyance, owing to excessive freight charges and high cost of suitable packing materials.

THE PREPARATION OF COCONUT COIR—

is being tried, and Sisal planting has been started on two estates.

A special chapter on the "Destruction of Insect Pests" is included in the report. This deals more particularly with a variety of

BLACK ANT

(*Technomyrmex Albipes*) which has increased markedly in recent years. It lives in simbiosis with two scale insects (*Mytilaspis* and *Lecanium*), which together with "snowblight" (*Icerya Seycheltarum*) do great damages especially to lime trees. It is not thought that insects parasitic on these insect pests will be sufficient to eradicate them, and consequently in addition to encouraging "parasitism" of this kind, spraying with soda-rosin solution is recommended. To assist in this work the

GOVERNMENT HAS IMPORTED SPRAYING APPARATUS,

and labourers have been taught to use these, and the services of these trained men are being placed at the disposal of planters to teach their estate labourers the spraying of trees. Attention is also directed to the necessity of cutting away all dead or dying tissue, and burning this so that it may not become a centre of further infection.

The report concludes with a chapter on "Deforestation," in which it is pointed out that owing to the hilly formation of the islands comprising the Seychelles group, a serious loss is suffered every year through erosion and the washing away of the surface soil. This loss could be partly obviated by the re-afforestation of the summits of the hills in those islands in which they have become deforested, and by better methods of cultivating the slopes. The latter are at present largely utilised for the

CULTIVATION OF MANIOC

(cassava). In digging out the roots, for which this crop is grown, the soil is loosened and broken up, and so brought into a state in which it is easily washed away by heavy rain. It is at present impossible to restrict the growing of manioc, since this is one of the principal food crops of the population. The Curator is, however, of opinion that these slopes might be afforested with *Albizzia moluccana* trees, in the shade of which coffee, cocoa, beans and other "edible" crops could be grown.—*Bulletin of the Imperial Institute, Vol. VII, No. 4* of 1909.

RUBBER IN THE STRAITS.

A CHAT WITH MR. W. N. TISDALL.

Mr W N Tisdall, who has just completed a four weeks' visit to the Straits, has returned with a very high opinion of rubber in that quarter. Speaking to a representative of the *Ceylon Observer*, he said that he had been as V.A. to Blackwater, where the rubber was growing very well, and to Lapan Utan. He had also seen Bukit Rajah, Damansara, Vallambrosa, Pendamaran, Highlands & Lowlands (including Ayer Kuning's 3,000 acres, a very fine concern), Seafield, one of the finest of the young estates, on which the growth of rubber was excellent, Batu Caves, another very fine property, and a number of small Chinamen's places near Kajang.

TAPPING.

One thing he particularly noticed was that on nearly all the estates the old farrier's knife or the gouge was being used. They did not seem to go in for the guarded knife, such as that used in Ceylon, and in one instance only did he see a patent knife. Excellent work, however, was being done and the tapping was very good indeed.

AN IMPROVEMENT.

Rubber had improved a good deal since he was there two years ago and the growth of rubber, after the third year, was a good deal better than in Ceylon, principally because the climatic conditions were better, there being, for one thing, a more even constant rainfall. The trees had a more even growth and the yield per tree was in excess of that of Ceylcn. The yield on the bukit or hill land promised to be better than that on the flat land, where the yield was greatly affected by the rainfall, the flow of latex stopping considerably when there was any tendency to drought.

THE CHEMIST,

The chemist, who had been brought out from England by the Rubber Growers' Association, had just arrived, and was going to live at Bukit Rajah and work from there. He (Mr. Tisdall) thought it was an idea which should be followed by Ceylon as anything which was likely to advance knowledge of the product was an excellent thing.

MANUFACTURE.

The rubber factories there on the older places did not come up to Ceylon in the way of buildings, which were mostly old converted coffee stores, with additions. The new estates were building good factories, but they were going in a great deal for natural drying, and not providing any Siroccos or drying machines. Naturally dried rubber was supposed to be of better quality, but it took ten days or a fortnight to do.

LABOUR.

Labour conditions seemed to be very satisfactory, and there was certainly not the same bother with advances. Most places seemed to have a sufficiency of labour although a few of the outlying places were short. Chinamen had taken very kindly to tapping and were doing very good work. They were considerably more expensive than Tamils but they did more work. A cooly to two acres was usually sufficient.

DISEASE.

There was nothing in the way of disease to cause any alarm, and the utmost care was being taken to prevent any danger in this respect.

WEEDS.

Most of the places were quite clean weeded. Passion flower was being used very largely for keeping down the growth of weeds, and for killing the lalang. It was, however, used only for the latter purpose, where there was a scarcity of labour as it was recognised that the best thing to do was to dig out the lalang, the operation although rather costly paying in the end.

OTHER INTERESTING VISITS.

He paid a very interesting visit to Kedah, one of the native states on the west coast, between Province Wellesley and Siam, and another to Kelantan on the east coast. He heard very good accounts of it as a rubber country, the soil being very fine, and the conditions good.

DEVELOPMENT.

The principal people opening land were the Duff Development Co., of Singapore, who intended to open several thousand acres.

A LACK OF SUPERINTENDENTS.

There was likely to be a scarcity of Superintendents as a good many men, having made their "pile," would be leaving the country very shortly. He knew of at least a dozen quite excellent billets which were unfilled.

OLD FRIENDS.

He saw a number of old Ceylon men there, including Messrs. R W Harrison, C Henly, W H Trotter, W R G Hickey and B C N Knight of Jebong.

FORWARD SALES.

He knew of the crops of several estates which had been sold forward at a very good figure for 1912.

FUTURE MOVEMENTS.

He was going to Periyar at the end of the week and after about seven days there he would return and take up some more visiting.

RUBBER IN B. N. BORNEO.

The Protector, Mr W H Penney, visited Si Bode Rubber Estate, the property of the North Borneo Trading Co., on the 11th inst. He reports that planting operations are being actively carried on and that it is expected 500 acres will be fully planted up by the early part of next year; about half this area is already planted and the growth is very satisfactory—*B. North Borneo Herald*, Dec. 16.

A NEW SOURCE OF RUBBER.

According to information recently received from Valpraiso a possible new source of rubber is

ATTRACTING ATTENTION IN NORTHERN CHILE,

which, if scarcely likely to greatly increase the supply under present conditions, merits further investigation and experiment. Along the arid coast-line, extending from the Tropic of Capricorn to about the latitude of Coquimbo, the annual rainfall is small and very variable in amount, although, in spite of statements often made to the contrary, the region is by no means a rainless one. Whilst on the whole characterised by desert conditions, the seaward flanks of the coastal mountains are well covered with cacti and hardy shrubs, particularly at considerable elevations, where the "garua," a damp mist, hangs persistently during the winter months. In the spring time, after exceptional rains, the forbidding aspect of the sun-scorched hills is completely transformed for a few weeks by the sudden springing up of a wealth of flowering plants of great beauty. Typical of the district and by no means uncommon, though rather restricted in its range, is the *Euphorbia lactiflua*, a shrub locally known as the "lechero," or "milkman," a term evidently derived from the milky fluid which exudes plentifully from any incision in the stem or from broken twigs, which continues to drip for some time after the injury. On exposure to the air the substance soon oxidises into a plastic and elastic solid, which is said to yield, under appropriate treatment,

RUBBER OF EXCELLENT QUALITY.

The shrub seldom attains great size, not often exceeding 10ft. to 15ft. in height, and does not cover much ground. When rain has supplied a little moisture to the parched soil, the stem and branches secrete the milky sap so freely that they become remarkably distended and turgid, sometimes even bursting. The plant does not flourish well near the sea level, and the present writer has not met with it at a greater elevation than a few thousand feet. The wounded bark appears to heal up rapidly, and it is said that the plant is not injured by process of "bleeding," by which the sap is collected. The milky exudation has long been made use of locally on account of its remarkable adhesive properties as a kind of natural glue, for which it forms an admirable substitute, and in past times the Indians of the desert coast fixed their stone arrow and lance heads to their shafts, and, it is said, poisoned their weapons with this substance. The juice is credited with possessing very poisonous properties, but appears to have been used medicinally by the Indians, some tradition of its mode of employment still lingering among the native Chilians.

The idea of utilising the products of the plant commercially has been advanced before but not very seriously, for at first sight, even supposing

ITS RUBBER PRODUCING QUALITY

to be confirmed, its comparative scarcity, restricted range, and small yield, together with the difficult nature of the country, would appear sufficient obstacles to prohibit its profitable exploitation. The difficulty of visiting the plants in order to collect the sap is, however, not so serious as it appears, since at the present time a certain class of the inhabitants go far afield in order to collect fuel in the shape of dead cactus branches and the like. Of more importance is the question of possibly

IMPROVING THE SHRUB UNDER CULTURE,

and the best method of increasing the number of the plants. The struggle for existence in the desert is very keen, water being the chief matter of difficulty. As artificial irrigation is quite out of the question, it may, perhaps, be found that the elimination of a few of the euphorbia's plant competitors would, without other attention, promote the growth of the shrub in greater numbers. Plenty of space is available for experiment, at any rate.

O. H. EVANS.

—*Field*, Feb. 5.

RUBBER IN VENEZUELA.

[We are indebted to a well-known Ceylon planter for the following interesting notes from his brother in Venezuela, which will interest a good many rubber-growers and others here :—]

Cuidad Bolivar, Venezuela, Dec. 28, 1909.—I have to thank you for yours of the 30th August, also for the parcel of

TAPPING KNIVES

which I duly received two mails ago. Though much interested in them and the rubber business generally. I am afraid there is absolutely no business to be done in them out here, even although the principal export of the country is balata and rubber. The reason is that the wretched natives who bring the stuff in from the forests, for it is all virgin, have to bring the greatest quantity possible to satisfy, which it never does, the rapacity of the people (mostly Venezuelans and Corsicans, both equal beasts !) in whose clutches they are. Consequently they

DO NOT TAP AT ALL, BUT SIMPLY CHOP THE TREES DOWN

and bleed them dry. Of course it is very short-sighted of them, as they have to keep on going farther afield the whole time for it. But such are the conditions which obtain in this country that it will never be otherwise until we get a decent, constitutional and equitable Government, which, I am afraid, will be a good while yet. We are

PLANTING A LOT OF RUBBER

on this estate ; we have some 26,000 trees now about two years old and are planting every season, but it will be some six or seven years before we start tapping them.

A CLIMATE OF PERPETUAL SPRING.

I am now pretty well settled down here and like the place very well. It is very healthy, the trade-wind blowing up the Valley the whole time. Fever is practically unknown amongst the whites. The prevailing climate is perpetual spring. This is also

A GREAT CATTLE RANCHING COUNTRY,

and alluvial gold is to be found in payable quantities almost anywhere in this district. The

people themselves are a lazy, useless lot and look like a lot of brigands. They are armed up to the teeth with revolvers, knives and swords, which they use freely on the slightest provocation. What I call "murders" are continually happening, but no notice is taken of the affairs. One good thing is they leave all foreigners alone, unless they interfere with them and their politics. Politics are at the bottom of nearly all the rows and troubles. Everybody is a "General" in this country. Our letters are brought to us by a General, also the bread and milk. We have several Generals working as miners and labourers. The army consists of 30,000 Generals and 10,000 others, only one of whom is a private, all the rest being at least corporals; but they are mostly captains and colonels. The women are nonentities. Such is roughly an idea of this place and people. The country itself is very pretty and is well watered.

DAMAGE TO RUBBER STUMPS.

FROM THE MOLE CRICKET.

(*To the Editor, "Malay Mail."*)

DEAR SIR,—Upon an estate on the alluvial in which I am interested, I find that as soon as my stumps begin to shoot, the shoots are very soon nipped clean off and removed. I have been told that the mole cricket is responsible, and have tried liming, tarring, and even bird-liming the stumps in the hopes of driving off or catching some of my enemies. I have had a watch kept at nights, and in fact have done everything in my power to check the pest, but totally without avail so far. I have heard it said that the only thing to be done is to pull up the bitten stumps and supply with young tree stumps 8ft. high. But unfortunately this latter suggestion does not come within the range of practical politics. I have now a gang on digging, with what success I cannot at present say, but if it is the mole cricket, I hope that the demoralising influence of disturbance may effect some good results. In the meantime I shall be most grateful for any assistance and advice, and would also be prepared to pay a handsome fee, if required, for a satisfactory remedy for the most serious insect attack which I have known in the course of a very long experience.—I am, etc.,

"MOLE CRICKET."

—*Malay Mail*, Feb. 12.

GRASS ON RUBBER ESTATES.

Planters will have read with much interest the letters quoted by Mr R D Anstead referring to "The Harmful Effect of Grass in Cultivations" and his remarks thereon which were published in a recent issue of the "Planters Chronicle." He says:—"I have on several occasions when discussing the use of weeds in cultivations of tea, coffee, etc., had occasion to point out that grass of all kinds is directly harmful and should be eliminated as far as possible, on account of its power of excreting a poisonous substance into the soil." This is a very startling pronouncement and it is based, apparently, on investigations carried out during the last 15 years at the Woburn Experimental Farm and described by Mr Spencer Pickering in a letter to the "Gardeners' Chronicle," which Mr Anstead reproduces. The latter, however, goes further than Mr Pickering, and it would be interesting to know on what grounds he is able to make so sweeping a pronouncement, viz. that "grass of all kinds" has the "power of excreting a poisonous substance into the soil." The idea of plants having toxic effect on soil is not a new one, but unless I am much mistaken, it was one that most scientists entirely disagreed with until quite recently; and Mr Pickering, it will be seen, only goes so far as to say, with exemplary caution, that "although no final solution of the problem has yet been obtained, considerable progress has been made in the matter and various possible explanations have been definitely negatived."

No tea or coffee planter will deny that grass does harm to his trees, especially in the hot weather. On the other hand, the rubber planter will argue that he is constantly being told by the scientist that it is better to leave his ground covered with a jungle growth than expose it to the sun's ray. Now Mr Anstead points out that land left untilled is taken possession of by grass and that grass spells ruin. The counsel of perfection for the rubber planter is, no doubt, to dig out weeds and grow leguminous plants between his trees, and many are doing this regardless of cost. What, however, would Mr Anstead have the rubber planter do whose means are limited—give his estate an annual dig, clean weed, or what? Or must we consider the replacement of jungle weeds by leguminous plants a *sine qua non* to successful rubber cultivation?

GEORGOS.

—*M. Mail*, Feb. 23.

CASTOR OIL BEAN IN THE SOUDAN.

EXPERIMENTS IN PRODUCTION.

The monthly report of the Soudan Central Economic Board for October says experiments were carried on at Kassala during the season 1908 9 with the cultivation of the castor oil plant, Java and Indian seed being used. The seed was sown early in September and the harvest took place about the middle of January. The beans were sent to Hull and there sold at about 11*l* per ton. The cost of cultivation and the yield per feddan were as follows:—

	Cost of cultivation per feddan.	Yield per feddan.
Java seed	4·479 *l* E.	1,840 rotls
Indian seed	3·725 *l* E.	1,729 "

The results of an examination, at Khartoum of samples of the beans produced, were:—

	Java.	Indian.
Percentage of oil	51·48	48·68
Weight of 100 seeds	42.6 grams	25·2 grams

The samples were both stated to be of good quality, that grown from Java seed especially so.

l E. equal 1*l*, 0s 6¼d; Rotl. equal ·99 lb; Feddan equal 1·04 acres.

—*Board of Trade Journal*, Dec. 2.

THEOBROMA AND CASTOR OILS.

At the second evening meeting of the Pharmaceutical Society of Great Britain held at 17 Bloomsbury Square, London, W.C., on December 14 (the President Mr. J F Harrington in the chair) Mr. C E Sage, F.I.C., F.C.S., read his paper on the

FIXED VEGETABLE OILS OF THE PHARMACOPŒIA.

Mr. Sage's lecture lasted about an hour and a half, and was illustrated by a large number of lantern-slides dealing principally with the machinery employed in oil-pressing. In the course of it he spoke of

THEOBROMA OIL.

The lecturer gave a very full account of the preparation of cacao. The beans undergo fermentation before being roasted, the latter being the most important part of the manufacturing process. After being cleaned by machinery the nibs are ground, and the pasty mass, containing 50 to 57 per cent of oil, is put into a press. The oil which exudes is coloured and is submitted to filtration in a hot room, when the white product familiar to pharmacists is obtained. The oil used in this country is pressed in England, which, said the lecturer, is a guarantoe of its quality. Ho would like to see the rubric "expressed in Great Britain" restored.

CASTOR OIL.

There are numerous varieties of *Ricinus communis*, the seeds of which yield castor oil. The size of the plant varies according to the country in which it is grown; in India and the United States it attains a considerable size. The oil was very largely used as lamp oil in India before the introduction of mineral oils, but now that the local demand has lessened a good deal of the seed is exported. Hull, the centre of the castor-oil trade, produces from 300 to 350 tons of oil every week. After describing the older processes as practised in India, Mr Sage gave details of how the oil is pressed in this country. The first step in cleaning tho seed is to pass them over a magnetic separator to collect iron nails and similar extraneous metallic matter. The testa is next removed by slight crushing and the seeds pulped. The pulp is then dealt with in a variety of ways, the "clodding" press being chiefly employed in Hull. The first pressings give the pharmaceutical castor oil if good sound seed has been used. An alternative process is to form the meal into cakes for packing into another kind of press. The oil as pressed is refined. This consists of heating it with fuller's earth and filtering by means of a filter-press. The press cakes are afterwards steamed and re-pressed, the product being a lubricating oil. Extraction by benzol is also practised. The lecturer gavo the following data regarding castor oil:

Castor Oil.		Iodine No.	Free Acid.	Saponification Number.
Pharmaceutical	..	83·5	0·94	178·7
First	..	84·6	1·08	175·9
Second	..	86·0	3·8	172·0

The lecturer concluded with a reference to soya-bean oil, which is at present "occupying the attention of the trade Press." In the

DISCUSSION,

Mr E M HOLMES—said: Enormous quantities of castor oil are employed for lubricating purposes owing to its peculiar viscosity and its cheapness. The Indian trade is largely in the hands of one man. Castor oil free from taste and purgative principle is used in China as salad oil. Although soya-bean oil has only been made within the last three years, the beans have been in the museum for the last twenty or thirty years. The oil is employed in the manufacture of margarine.

Mr E T BREWIS—after referring to the interesting nature of the paper, said soya-bean oil has been pressed for many years, but has not up to now found many outlets in this country.

Professor H G GREENISH—said the lecture would be much appreciated by students on account of its practical character. Is it necessary, he asked, to spend so much time in preparing the seeds before pressing? He once saw a working process, in which the castor seeds were pressed whole, and understood that other seeds were treated in the same way. In regard to the formation of oil in the seeds, the oil forms in globules in the protoplasm; but although the problem is not yet solved, the evidence goes to show that it is not produced from the mannite.

Mr SAGE—in reply to Professor Greenish—said that he knows of one mill producing 25,000 tons of castor oil a year where the seed undergoes no preparation before pressing. The cakes are extracted with benzol, and after removal of the poisonous principle are used for cattle-feeding. In regard to the physiological processss that lead to the formation of oil in plants, his impression was that bacteriological action played as active a part as enzymes.—*Chemist and Druggist.*

"DIE-BACK" OF HEVEA BRAZILIENSIS: FATAL CASES.

THE LATEST PERADENIYA CIRCULAR.

The latest Botanic Gardens circular, recently to hand, consists of a treatise by Mr. T. Petch, the Government Mycologist, on "Die-Back of Hevea Brasiliensis." The subject is exhaustively dealt with, and the writer's observations and suggestions will be found of great value to all rubber planters. A serious aspect of the disease is that, whereas, a few years ago, it was essentially one which attacked trees from one to two years old only, it was last year found on several estates on trees from nine to 14 years old, in some cases killing them with astonishing rapidity. The disease kills back the tree from the top; although its earlier stages generally attract attention in the case of young trees, they are seldom noticed on old trees. The fungus which begins the disease attacks the leading green shoot; the place attacked becomes dark brown, and this discolouration gradually extends over the whole shoot, while the leaves fall off as the fungus reaches them. If the dead shoot is then cut off, the tree sends up a new leader from the uppermost remaining bud, and the disease is thus got rid of with very little damage to the plant. If it is neglected, the

"die-back" frequently continues down the stem until it reaches the root and the tree is killed outright. It is not, therefore, a very serious disease in the case of young trees, provided that they are not left to take care of themselves. After dealing with the fungi which originate the disease and with the latter's symptoms, Mr. Petch states that the tops of trees attacked by "die-back," having been cut off below the dead part, must be burnt; and he goes on to point out that if the diseased stems are left lying about the plantation they will hatch out myriads of Botryodiplodia spores, all ready to attack other trees when they get an opportunity. Botryodiplodia elasticae is an extremely widespread fungus, and it would be quite impossible to eradicate it, but there is no need to encourage it by neglecting to remove the dead stems. It grows excellently on all dead stems of Hevea, no matter what the cause of death, and any one can obtain specimens of the fungus by cutting down a healthy tree and leaving the stem on his verandah for a fortnight. It is fortunate that the fungus is not a direct parasite of Hevea, but can only attack it through wounds or dead branches. The diseased part should be cut off with a slightly sloping cut. It should not be too oblique, or the upper thin edge will die. If the dead portion is large, it should be cut down in pieces, so as not to injure the lower branches. The cooly will no doubt prefer to use a catty, but if so the stem should be finally trimmed off with a saw to get a smooth surface. The removal of dead branches, which may afford an entrance for Botryodiplodia and other fungi, will have to become part of the general routine of a rubber plantation, and some coolies should be taught how to do this properly. The removal of a large branch requires three cuts with a saw. The first is made, about a foot away from the trunk, on the under surface of the branch and about half-way through it; the second is made from the upper surface three inches further from the trunk, and continued until the branch breaks off. The double cut prevents any damage to the main stem. Finally, the stub must be sawn off as close to the stem as possible; it must be cut off flush with the stem, not perpendicular to the branch. This may give a bigger wound, but it will heal completely, whereas the bark will never grow over a triangular stub. The cut surface must be tarred to prevent the entrance of fungi. The heartwood of any tree is practically dead, and, if exposed, can be readily attacked by many fungi which could never obtain a footing on the tree under other circumstances. The progress of such fungi is slow, but the tree ultimately becomes hollowed out or weakened to such an extent that it is broken by wind. Coal tar should be used for covering the cuts. It is much more permanent than Stockholm tar and more effective against fungi. Of course, the cooly should not be allowed to use so much that it runs over the healthy bark, and to avoid this it is better to use it cold. Hot tar is best, but there is more danger of injury. The cut surface should be as dry as possible, but it should not be left exposed for more than a day before being tarred. Those two points may conflict in practice, and it is a matter for compromise. To avoid the disease caused by the fungus attacking stumps the holes where the stumps die should be lined, and supplied with basket plants. Mr Petch follows the above with an interesting account of the distribution of the fungus and the conclusions he draws are that dead branches should be regularly removed and burnt, in both cacao and hevea plantations, that it is unwise to allow albizzias planted in tea or rubber to grow into large trees and then to cut them down, that, when albizzias three inches in diameter are pruned at a height of three or four feet, the cut surface of the stem should be tarred to prevent them dying back, and that to interplant cacao and rubber is unsound, seeing that they are attacked by the same fruit, stem, and root diseases. The circular is concluded by a reference to climatic leaf fall in hevea which in some respects resembles "die-back."

CAMPHOR ON THE GOLD COAST.

A Recent Peradeniya Visitor's Report.

An introduced crop that gives exceptional promise is camphor (Cinnamon camphora), plots of which have been established at three of the agricultural stations. It shows very satisfactory growth, as will be seen from the notes on the stations, and is far better than trees of similar age in Ceylon, where, to a limited extent, it is now being cultivated and the camphor extracted by distillation and sublimation from the leaves and twigs. This is a form of cultivation that might profitably be taken up in this Colony by some of the more intelligent planters. Japan has hitherto practically held a monopoly in this product, the trees yielding it being indigenous to the forests of Formosa, and it is only within the last few years, owing apparently to an insufficiency of supply and consequent increase in price, that its production has received scientific investigation. Camphor is an important element in certain manufactures, notably celluloid, and in the manufacture of explosives, and unless synthetic camphor can be manufactured at a price below that at which the natural product can be produced, it is reasonable to suppose that this may prove profitable to cultivate. Cinnamon also grows well and could be produced on a commercial scale should it be remunerative enough to do so ; but at the present prices I could hardly recomend it.—*Official Report on 1908*, by W. S. Tudhope, Director of Agriculture.

TOBACCO GROWING IN U.S.A.

A report on experiments in tobacco growing which have been carried on at the Agricultural Experiment Station of the University of Wisconsin states that the use of manures free from chlorine was found not to exert any detrimental effect on the burning quality of the leaf.—*West Indian Agricultural News*, Dec. 11.

INDIGO AND SUNN HEMP AS GREEN MANURE.

(*To the Editor*, "*Madras Mail.*")

Sir,—I beg to approach you with the confidence that the agricultural population of the Cauvery Delta may be benefited by the publication of the following news in your columns. The Agricultural Department has stocked Sathier wild indigo (*Kaavaalay* or *Kolonji*) Nandyal indigo (*Avery*) and Bezwada Sunn hemp at Ammapet, Nidamangalam, Koradacheri and Nannilam, S.I.R., and sell them at cost price. These are to be used as green manure. The first two may be seen alone, or together, with field gram, and cattle do not graze them. Sunn hemp serves the triple purpose of fodder, fibre and manure, for the first two uses of which it can be advantageously sown now. If green manure, the fitting season for wet land is just after the new freshes have come in, when they are sown on ploughed land and used as green manure within four to six weeks, when the field may be required for the transplantation of Samba. The seeds can be had on application to Mr. C Narayana Iyer, Agricultural Inspector on special duty, Camp Nannilam.

V. V. SUNDARAMIER.

—*M. Mail*, Jan. 11.

TUBERCULOUS ALIMENTARY PLANTS

(*Review.*)

We have received from Messrs. O. Doin and Sons, Paris, a neat and compact little book of some 400 pages, written in French by Professeur Henri Jumelle, of Marseilles, and entitled "Les Plantes à Tubercules Alimentaires des Climats Tempérés et des Pays Chauds," (Tuberculous Alimentary Plants of both Temperate and Tropical Climates), which, as far as we can gather, is a valuable addition to botanical, agricultural and industrial literature. In it all plants, the tubercles of which are used for food or for the preparation of starch, are reviewed from the three points of view mentioned above, For each plant the author has given a description of the type and its varieties, reproduced analyses of the tubercles, mentioned their principal properties, and indicated the processes of cultivation and harvesting, the whole forming a most excellent résumé, embellished by the results of the author's own observations and study, of the numerous and important researches which have recently been made in tropical countries with reference to the manioc and its varieties, yams, the sweet potato, and other plants, as well as of what is already known with regard to tuberculous plants in temperate climes. The first chapter explains what a tubercle is, the mode of formation and its anatomical construction, describes the different varieties, and treats of the localisation of their reserves, such as starch from the potato, and saccharine from the beetroot. This chapter is of interest principally to botanists. The others are written from the triple point of view mentioned in the first sentence, giving exhaustive information regarding the potato, the manioc, yams, the sweet potato, arrowroot plants, the colens, the tuberculous monocotyledons, and apetalous, dipetalous, and gamopetalous plants. The particular value of the book is that, although a large part of the information contained therein can be obtained separately in larger and more expensive books, it forms a handy treatise containing the principal facts of interest in connection with the subject, dealing with all plants appurtenant thereto irrespective of the climate in which they thrive. The letterpress is illustrated and elucidated by a number of sketches of plants and machinery, and chemical and other tables.

TRIPOLI ESPARTO GRASS.

For more than fifty years Great Britain has been a large importer of esparto grass for use as paper stock. This fibre, called variously "esparto grass," "Spanish grass," "halfa," and "alfa," is found in Southern Spain, Algeria, Tunis, and Tripoli. The pulp-making process does not differ greatly from those of other paper stocks ; the esparto grass is boiled with caustic soda, washed, and bleached with a chlorine solution. It has been imported into the United States on trial, but seems not to have been able to compete with wood pulp. According to the American Consul at Tripoli, esparto grows wild in Barbary, and is brought in on camels to Tripoli and one or two of the smaller towns on the coast. The shipments from the district average from 35,000 to 40,000 tons per annum, and occasionally exceed the latter figure. The supply is affected by the state of other crops. In a good year the barley fields attract many esparto gatherers ; in a very bad year it is difficult to find camels to bring the grass to the coast. The slack season is from October to February, an improvement then begins which lasts until the barley harvest time. During one day in April, 1909, as many as 1,800 camels loaded with esparto came into the market at Tripoli. The grass is sold by public auction, and then delivered to the "funduks," or warehouses, of the exporters. Then it is sorted and baled by hydraulic pressure. The bales weigh about 600 pounds. The trade is in the hands of three large firms, who have esparto presses in Tripoli, and in one or two of the smaller towns along the coast. The shipment is mostly by chartered steamers, and the entire output goes to England.—*Journal of the Royal Society of Arts*, Dec. 31.

COFFEE IN THE PHILIPPINES.

From the trade and commerce report of the Philippine Islands we learn that the coffee-planting once a thriving industry in the islands, has been steadily on the down-grade for the past twenty years owing to the coffee blight, and that imports of coffee have in this period been steadily increasing, British India being, until recently, the chief source of supply. Java, however, has commenced to compete, and in 1908 the imports of Java coffee were almost equal in value to the British Indian product.—*M Mail*, Feb. 8.

Photo *H. F. Macmillan*

CALABASH NUTMEG.

Calabash Nutmeg, also called Jamaica Nutmeg (*Monodora Myristica, N. O.* Anonaceæ).—A moderate-sized handsome tree, with large oval, shiny leaves and sweet-scented flowers. It is a native of West Tropical Africa and has been established since 1897 at Peradeniya, where it flourishes, but has not yet produced fruit. In its native country the aromatic seeds, which are enclosed in a large globular fruit, are used as a spice for flavouring purposes, being considered to resemble in character the nutmeg proper. The tree is suited to the moist low-country up to about 2,000 ft., and thrives best in deep loamy soil.—H. F. M.